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The impact of online peer influence and information modality on investor decision making.

Thesis presented by:

Luke Merriman, BSc

For the degree of MSc (Commerce)

January 2020

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Declaration

This is to certify that the work I am submitting is my own and has not been submitted for another degree, either at University College Cork or elsewhere. All external references and sources are clearly acknowledged and identified within the contents. I have read and understood the regulations of University College Cork concerning plagiarism.

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Luke Merriman

Abstract

The growth in online investing is illustrated by the popularity of online investing platforms and the growing pool of literature within the field. The internet and online investing platforms have allowed investors to directly invest funds with no intermediary, with low capital requirements, and low commissions and fees. While the internet has significantly simplified the investment process, it has also introduced new ways investors can process and receive information. From this, the overall objective of exploring how information is processed and received by investors, through the lens of copy trading, social media and information modality was developed in this research. Existing literature points out tendencies among online investors to use social media to gather investment-related information, leading this research to the exploration of social media usage among online investors in Chapters 2 and 3. Chapter 2 explores emerging social trading networks in which investors have full visibility of others' trades, which they can copy directly; this is referred to as copy trading. The transparency of copy trading adds to the information available to investors online, as investors can inform their own investment decisions based on others'. The research identifies drivers of investor engagement in copy trading. Following this, Chapter 3 further explores the communication of investment-related information on social media and the corresponding impact of social media usage on investor overconfidence. In terms of exploring how online investors receive information, existing literature in the field of information modality suggests that emerging voice-based user-interfaces such as Amazon's Alexa have resulted in increased consumption of audible information. With investor information in mind, Chapter 4 explores the impact of combined audible and visual information on investor decision making. Results from Chapter 2 identify that for online investors to engage in copy trading, they must be provided with sufficient information to trust the investor they are copying. From there, Chapter 3 described how online investors who use social media to gather investment-related information are overconfident in their investment decisions. Finally, Chapter 4 highlights the superiority of visual information over combined audible and visual information in the context of online investing.

Chapter 1. Introduction

1.1. Introduction overview

Online investing has seen significant growth in recent years; this is illustrated by the growth of online investing platforms. TD Ameritrade, a US-based online investing platform, had 11.5 million funded client accounts as of September 2018, an increase of approximately 40% from 6.9 million in September 2016. The platform averaged 811,110 client trades per day, up approximately 45% from 510,070 trades per day in 2017 (US SEC, 2018). E-Trade, a competitor of TD Ameritrade, also offered an online trading platform and recorded a total of 4.9 million brokerage accounts in December 2018, a growth of approximately 35% from 2017 (US SEC, 2018). While these statistics demonstrate the surge in popularity in these relatively established online trading platforms, newer competitors such as Robinhood are offering users similar features at a lower cost. In February 2018, Robinhood had 3 million active trading accounts with a median user age of 28 (Chafkin, 2019). The platform enables its users to invest in exchange-listed US stocks, exchange-traded funds, and cryptocurrencies, and they can do this commission-free. 2019 has seen the mobile banking platform Revolut enter the online investing market by launching its in-app trading feature. This feature allows Revolut users to trade over 450 individual stocks with low commission rates (Horne, 2019). While these platforms vary in terms of costs, features and available asset classes, they all allow investors to bypass intermediaries such as brokers and independently invest their funds.

When directly investing online, investors can gather larger volumes of information to inform their investment decisions. Leskovec (2011) describes how social media has altered how information is produced and consumed online. Social media platforms allow users to easily generate widely accessible information, often in the form of users' opinions. Existing literature analysing investment-related information on social media identifies a link between the opinions of social media users and market movements (Bollen et al., 2011). This suggests that investors use social media to both generate and gather investment-related information online. This is most notably demonstrated in social trading networks such as eToro, specifically designed for investors to share and copy each other's investment

decisions (Glaser & Risius, 2018). The volume of investment-related posting online, combined with the growing popularity and pool of literature on social trading networks, suggests that investment information, sourced through peer opinions on social media, is becoming increasingly influential among online investors.

In addition to the growing consumption of investment-related peer opinions online, emerging technology is changing the way online information is being communicated, perhaps most notably in terms of information modality. Voice assistants such as Amazon's Alexa or Apple's Siri generally produce information in a singular, audible mode. Advancements in natural language processing (Hirschberg & Manning, 2015) allow these assistants to interact with users. More recently, Amazon's Echo Show produces information in audible and visual modes. Alexa communicates information audibly and the Echo Show screen communicates information visually. The combined audible and visual modality of information has been researched in the past and in certain instances, identified as a more effective method of communication than solely visual information (Inan et al., 2015; Leahy & Sweller, 2011; Moreno & Mayer, 1999). While traditionally investors receive information in a solely visual way online, communicating combined audible and visual information using devices such as Amazon's Echo Show could influence how effectively investors process information prior to making an investment decision.

While the means online investors have of receiving information, both visually and audibly, can impact on their financial decision-making, the source of this information can also impact on investment decision-making. Investors, dealing with multiple sources of financial information, can opt to concentrate on one source of information and to copy the advice given. It has been established that investors use social trading networks to copy others, however, there remains a paucity of research exploring what drives investors to engage in copy trading. Similarly, the use of social media by investors to gather investment-related information has been thoroughly researched, however, the corresponding changes to investor behaviour have not been examined. Finally, the consumption of combined audible and visual information has become more prevalent as a result of emerging voice technology and has not been examined in the context of online investing. Overall, the use of

social trading networks, the use of social media and the consumption of combined audible and visual information among investors is addressed during this study. Each area remains focused on how investors process and receive investment-related information. From this concept, the overall research objective of this thesis is derived: Explore how information is processed and received by investors, through the lens of copy trading, social media and information modality.

1.2. Study background

Over the course of the last 15 months, the research presented in this thesis focused on emerging trends in online investing, online investor behaviour, and specifically how investment-related information is communicated online. The research was conducted in University College Cork as part of a master's by research, on the subject of Financial Technology, in the State Street Advanced Technology Centre. The research conducted during this thesis was assisted by the industry guidance of the State Street Corporation and State Street Global Advisors. Throughout the program, meetings frequently took place with industry stakeholders from State Street. These meetings were used to discuss the progression of the research and its future directions. The industry guidance allowed for the research to be academically focused without losing sight of the financial services industry, relevant emerging trends, and opportunities within the industry to explore with research. An industry report, titled *The Future of Investing*, was provided to State Street based on early research during the program. This report is attached at the bottom of this document in appendix A.

The industry guidance is demonstrated by the development of a proof-of-concept (POC) Amazon Alexa Show system developed during the program. State Street stakeholders emphasised how the introduction of voice assistants such as Amazon's Alexa are changing the way information is communicated and pose disruptive potential in the financial services industry. This initiated the development of the POC. Stakeholders from State Street regularly provided guidance on the system in order to optimise its features for both academic and industry research. The research targeted changes to information modality arising from devices such as the Amazon Echo Show and the corresponding changes to retail investor decision-making. The system was designed to imitate existing systems that investors use to receive information, with the inclusion of audible information. Due to the complexity and

novelty of developing a system on a device as new as the Amazon Echo Show, regular industry guidance was required from State Street to allow for the continuous refinement of system features until it was deemed adequate for empirical research. At the end of the master's program, the functionality of the POC, along with the results of the research were presented in State Street's Dublin headquarters. The presentation slides are attached at the bottom of this document in appendix B. The POC received a very favourable response, with many State Street employees asking questions about, and showing an interest in, the POC and its potential within their organisation.

Academically, the master's program began by focusing on refining and improving research skills to a level sufficient to conduct both industry and academic research. Initially, developing an ability to accurately review existing literature was emphasised. Literature reviews were conducted to derive clear and relevant research objectives. These research objectives were then pursued during the master's program.

The democratised nature of online investing was identified during initial literature reviews. This shed light on the ease with which individuals could directly invest their funds online with no intermediary, at low costs and with very little capital. Upon further exploration of the topic, it was noted that research in the field of online investing was growing at an accelerating rate and the industry itself was thriving as a result of innovative, disruptive technologies. This encouraged the further exploration of the literature, from which further research opportunities were considered. It was noted that modern online investing platforms such as social trading networks appear to be growing increasingly relevant. The subsequent behavioural implications of the growth of these platforms and the way they change how investors receive and process information had limited prior research. Similarly, it was noted that emerging technology is significantly disrupting how information is communicated in the financial services industry; however, certain technologies had not been explored in the context of online investing.

1.1. Individual contribution

The research conducted during this thesis began broadly and narrowed throughout the master's program. As a result, elements of the research were conducted

collaboratively. Chapters 2 and 4 were collaborative pieces of research, Chapter 3 was conducted individually by the author of this thesis. Initially, online investing was the primary scope of the research, the broad nature of this topic required the work of three individual researchers. In Chapter 2, a systematic literature review was conducted collaboratively to review literature as broadly as possible. Three main steps were required to conduct the review. One researcher performed the first step of the review, investigating online investing literature in leading journals and databases. One researcher performed the second step, reviewing citations from articles identified during step one. The thesis author performed the third step, identifying studies that cite the key articles identified in steps one and two. Following this, one researcher further investigated literature on perceived usefulness and ease of use as underlying drivers in investor engagement in copy trading. One researcher further investigated literature on perceived enjoyment and signal provider trustworthiness as the two remaining underlying drivers in investor engagement in copy trading. The thesis author designed the framework modelling investor engagement in copy trading based on these underlying drivers and wrote the research chapter. Chapter 4 addressed the impact of information modality on investor decision-making. While this scope was narrower, it also required the collaborative work of three researchers. One researcher developed the Amazon Echo Show POC, one researcher conducted the interviews and tests used to gather data and the thesis author designed the interviews and tests carried out and wrote the research chapter upon completion of the study.

1.2. Research questions

Based on these opportunities for further research, the overall objective of the thesis was derived: to examine how information is processed and received by investors, through the lens of copy trading, social media and information modality. The multi-faceted nature of this objective required it to be separated into 3 individual research questions. While each question explores different topics such as social media and information modality, they align with the overall objective by addressing the ways in which investors process and receive information. These research questions were formed on the basis that they would target gaps in existing literature, contribute to the overall field of research in online investing, and ultimately provide avenues for further exploration. Each research question was explored and presented in

individual chapters of this thesis. Figure 1-1 illustrates how the first research question was derived along with its overall contributions to the thesis.

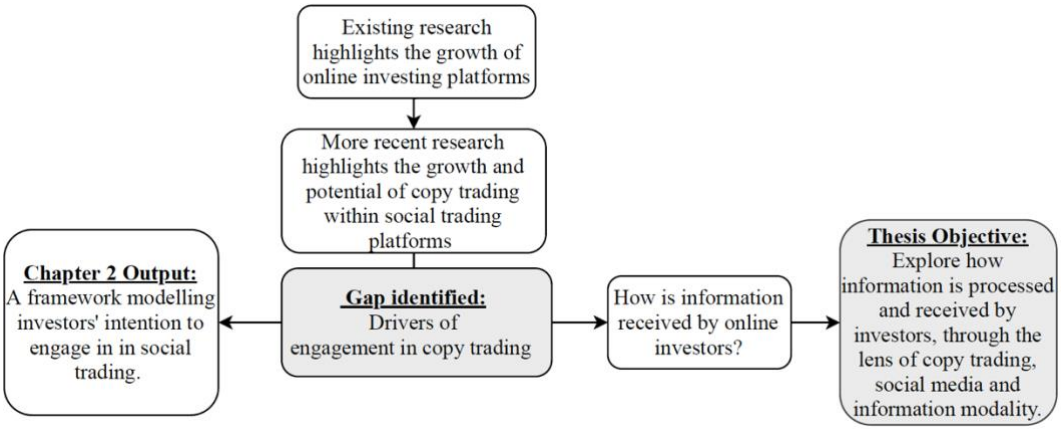


Figure 1-1: Breakdown of the gap identified for Research Question 1 and its contribution to the thesis.

Research Question 1: What drives participants in social trading networks to engage in copy trading?

Social trading networks are online communities specifically for investing in which investment decisions are published in real-time for any participants in the network to see. Participants can follow other investors who publish their trades. By making this information available to investors, social trading networks allow participants to decide whether or not they want copy others. If an investor decides they want to copy another's trades, the copy trading functionality of these networks allows for the direct and automatic copying of other investors' decisions. The transparent nature of these networks, combined with online investors' tendencies to gather information through others' opinions online prior to making investment decisions, has led to a quick growth in social trading popularity.

With this growth in popularity in mind, Chapter 2's research question was formed. The study analysed existing literature to identify what drives participants in social trading networks to engage in copy trading. By identifying the drivers of engagement in copy trading, online investors' attitudes towards social media would be further explored; this will shed light on online investor peer influence. This question was answered using a systematic literature review, in which existing literature in online investor behaviour, social trading networks and specifically copy trading was analysed and synthesized. A theoretical framework illustrating the

drivers of copy trading engagement was created to be the primary contribution following the aggregation and analysis of existing findings.

One particular finding from this literature review was the perceived enjoyment online investors derived by engaging in copy trading. Three underlying drivers of this perceived enjoyment were identified, these were the self-attribution bias, the illusion of knowledge and the illusion of control. While these characteristics were found to drive perceived enjoyment in copy trading for participants in social trading networks, they had also been identified as drivers of overconfidence among online investors in existing literature (Barber & Odean, 2002). The characteristics were researched and validated as reasons for overconfidence in early online investing literature, however, they had yet to be explored from the perspective of online investor social media usage. From this finding, the second research question was developed. This is illustrated below in Figure 1-2.

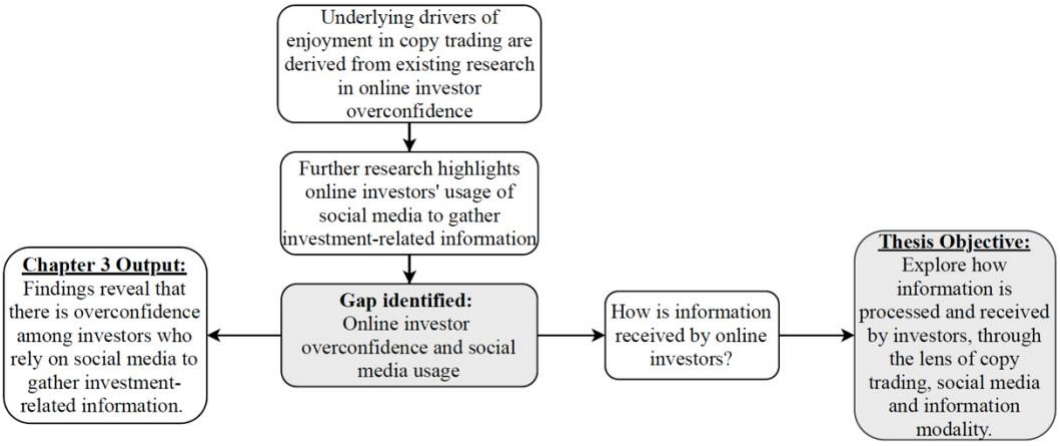


Figure 1-2: Breakdown of the gap identified for Research Question 2 and its contribution to the thesis.

> Research Question 2: How is online investor overconfidence impacted by social media usage?

The ability to invest funds online directly, with no intermediary, allows for lower capital requirements and lower fees. In combination with this, the wealth of information openly available online significantly lowers the cost of gathering information to inform investment decisions. While these factors appear to be beneficial, online investors are found to make speculative and excessively frequent investment decisions as a result. These tendencies are driven by overconfidence

(Barber & Odean, 2001a). As identified during the exploration of the first research question, existing research is yet to consider the implications of social media usage on online investor overconfidence. This led to the further exploration of online investor social media usage.

The study intended to build on the findings from the first research question by further investigating online investors' usage of social media to gather other investors' opinions and imitate others' investment decisions. Following this, the study focused on the behavioural implications of using social media as an information source to inform investment decisions. It was suggested that social media usage by online investors would facilitate the self-attribution bias, the illusion of knowledge and the illusion of control increasing overconfidence. Therefore, overconfidence could be examined through the lens of these three characteristics. This contributes to the overall objective of this thesis by identifying the ways in which peer influence, via information on social media, impacts on online investor overconfidence.

By focusing on overconfidence as a result of social media usage, the study explores how online investors receive information. It was noted that social media's growing presence in the field of online investing has changed how information is received; however, the way in which the information is communicated to online investors was not previously examined. There is a growing pool of literature exploring how emerging technology, specifically voice-based interaction, is providing information audibly as well as visually, changing the way information is communicated. While this concept is extensively examined in existing research, it was noted that existing

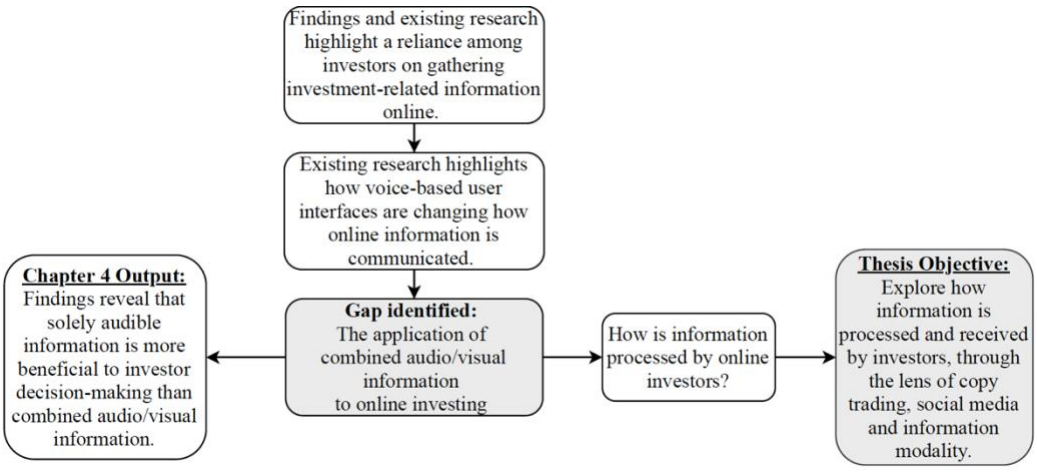


Figure 1-3: Breakdown of the gap identified for Research Question 3 and its contribution to the thesis.

research does not explore this concept within online investing. Figure 1-3 illustrates how the third research question was derived from this finding, along with its contribution to the thesis.

> Research Question 3: Can the combination of audible and visual information enhance an investor's ability to learn from investment-related information and ultimately better inform their investment decision?

Advances in natural language processing and voice-based user interaction has resulted in the increased use of voice assistants. The main implication of this emerging technology is that information is being more commonly communicated audibly, as opposed to visually. In the context of online investing, the study considers how investors can interact with Amazon's voice assistant, Alexa, audibly and visually using new products such as the Echo Show. In order to explore this concept, existing literature examining the communication of combined, audible and visual information was analysed.

The modality effect was identified, which states that an individual's ability to learn from information is enhanced when the information is communicated in two combined modes: audibly and visually. While validated by existing literature, this concept had not been explored in the context of communicating information to online investors. This study explored this concept by examining whether an investor's ability to make an investment decision is enhanced when audible and visual information is communicated concurrently. The findings contributed to the overall research objective of the thesis by investigating how emerging technology, providing combined audible and visual information, impacted investor decision-making.

Figure 1-4 illustrates how each research question was derived from gaps identified in existing literature. The output of each research question, along with each question's contribution to the overall thesis objective is also outlined.

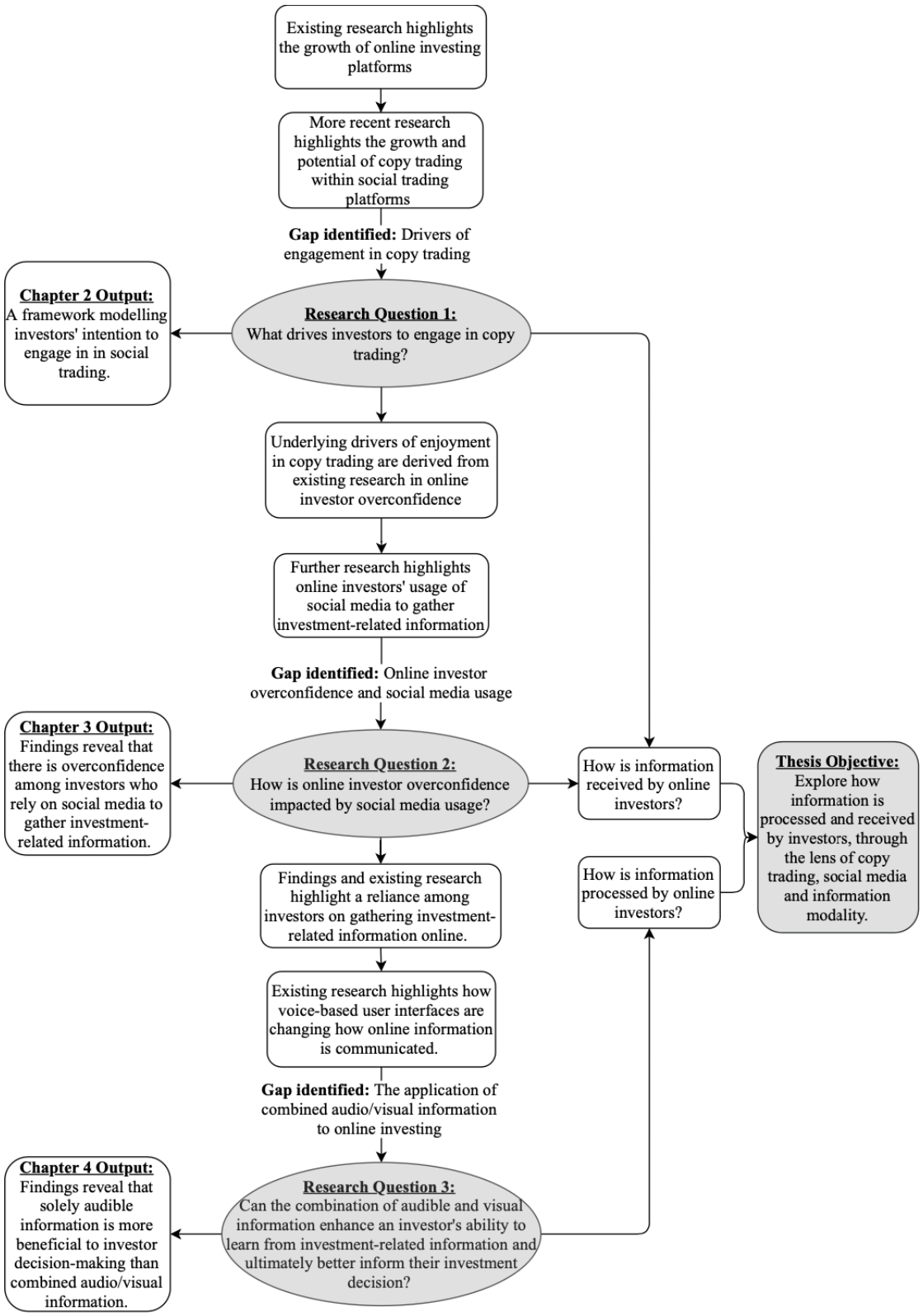


Figure 1-4: The flow of the overall thesis structure with each chapter's output and contribution to the thesis objective.

1.3. Research methodology overview

To answer the three research questions, different research methods specifically suited to each question were required. Each method was discovered during early reviews of existing literature related to the relevant research topic. Each research method's applicability was considered in the fields of information systems, financial services and specifically online investing. Prior to choosing the research methods, their validity and relevance specific to each chapter's research question was considered.

While the research methods for gathering data in this study vary to a certain extent, literature reviews informing each chapter were kept consistent. Extensive literature reviews were conducted to analyse and synthesize existing literature. Each of the 3 chapters followed the methods and guidelines of Webster and Watson (2002). These guidelines have been followed and validated during research in various relevant fields such as information technology (Melville, Kraemer, & Gurbaxani, 2004) and information systems (Levy & Ellis, 2006). By following the same literature review method across the three chapters, the reviews were consistent across the thesis. The method required three steps. Firstly, leading journals and journal databases were investigated for literature relevant to the study's objectives. Following this, the citations in the articles identified in step 1 were reviewed to identify prior studies in the appropriate field. Finally, online academic databases were searched to identify studies that cite the key articles identified previously, this allowed for the analysis of more recent research in the relevant field. Following these three steps, a concept-centric matrix was created using concepts from all of the articles identified during the reviews.

In Chapter 2, the concept-centric matrix was used to aggregate the results of existing literature. Key concepts from research papers in the areas of online investing, social trading networks and copy trading were the focus of the literature review. Once identified, these key concepts were included in the concept-centric matrix to synthesize the trends in existing literature. The concept-centric matrix was then used to identify the underlying drivers and their subcomponents of investor engagement in copy trading. From the trends identified during the systematic literature review, a framework was derived demonstrating the underlying drivers and their subcomponents. The underlying drivers were examined at a more granular

level; this involved isolating the concepts from existing literature by units of analysis. These units of analysis were then used to identify subcomponents of the drivers of engagement in copy trading.

Similarly, Chapters 3 and 4 used Webster's and Watson's (2002) guidelines to perform a systematic literature review. The reviews also utilised a concept-centric matrix to identify recurring concepts from existing literature. In Chapter 3, these concepts were used to examine overconfidence among online investors initially. Following this, the concept-centric matrix highlighted recurring concepts from previous literature discussing investor usage of social media to gather investment-related information. From there, questions for interviews were derived to examine the impact of social media usage on online investor overconfidence. In Chapter 4, the concept-centric matrix was utilised to highlight areas from existing research which examined the effectiveness of communicating combined audible and visual information. From there, appropriate features for a system providing audible and visual information were derived. This assisted with the development of the Amazon Echo Show system used to address the impact of information modality on online investor decision-making.

Chapters 3 and 4 required participants to take part in interviews and testing to gather data. Key informants were selected as appropriate participants. They were selected on the basis that they were knowledgeable in the area being researched and offered more in-depth, informed responses than survey participants representing a certain sample. In Chapter 3, all interview participants were considered key informants as they were individuals who have directly invested their own money online and are willing to share how they gather information which informs their online investment decisions. By interviewing key informants who specifically use or don’t use social media to inform their investment decisions, comparisons could be made to identify the impact of social media on online investor overconfidence. Again, key informants were used in both studies for consistency. In Chapter 4, key informants were selected from a group of investors running and managing a retail investment fund. The use of key informants who were experienced in online investing, allowed the study to thoroughly examine the impact of communicating combined audible and visual information on online investor decision making.

Chapter 3 utilised semi-structured, qualitative interviews with key informants. The use of these interviews had been validated by Myers and Newman (2007) as a method of collecting data in the information systems field. Semi-structured, qualitative interviews allowed the interviewer to critically analyse and adapt to different answers provided by participants. The semi-structured nature of the interviews also allowed participants to describe relevant thoughts and experiences in more detail. Exploring the broad nature of online investor overconfidence and social media usage required participants' answers to be detailed with as little ambiguity as possible. The adaptability of semi-structured interviews allowed interviewers to ask more questions about any topics that required further refinement. This resulted in the gathering of more detailed qualitative data used to answer the chapter's research question. The interviews consisted of ten questions initially, however as they were semi-structured, the total number of questions asked during the interview depended on the participant's answers. The first questions explored each participants' online investing experience. This was followed by questions examining overconfidence, and finally each participant's usage of social media to gather investment-related information was questioned.

Chapter 4 involved the development of two Amazon Echo Show proof-of-concept systems. These two systems were then used for comparative testing with online investors. A Repertory Grid (RepGrid) analysis was utilised with key informants to elicit features and functionalities of the systems. The RepGrid analysis was used on the basis that it improves the interpretability of an interview participant's views and opinions (Kelly, 1977). This allowed for the development of relevant and usable systems for testing. It was also selected on the basis that in the in the context of information systems, it is validated as method of gathering qualitative, unbiased data (Hunter, 1997). In testing the Amazon Echo Show systems, two separate groups of key informants tested two separate systems. One group tested a system that communicated solely visual investment information, the other tested a system that communicated combined audible and visual investment information. Each groups ability to retain and transfer information was examined following their interaction with the systems. By comparing each group's ability to retain and transfer investment-related information, the study examined how combined audible

and visual information impacts an investor's ability to learn from investment-related information and therefore, impact their ability to make investment decisions.

Chapter 2. The delegation of investor decision making: What drives investors to engage in social trading.

2.1. Abstract

This study analyses existing literature to identify what drives investors to engage in copy trading. A concept-centric review of literature extracts recurring, relevant concepts and builds insights used to inform an Investor Engagement Framework which models the drivers of investor engagement in copy trading. It is considered that the underlying drivers of the Technology Acceptance Model alone aren't adequate in describing what drives social trading participants to engage in copy trading. The addition of affect-based signals and cognition-based signal augments the model to reflect trustworthiness in social trading networks. These results firstly outline that the Technology Acceptance Model needed to be extended when applied to the context of copy trading within social trading networks. Secondly, the results suggest that for a participant in a social trading network to engage in copy trading, the investor they copy must provide affect-based and cognition-based signals of trustworthiness.

2.2. Introduction

Social trading networks are described by Wohlgemuth, Berger, and Wenzel (2016) as online communities in which investors can follow others and directly copy their investment decisions. The transparent nature of these networks has led to their quick growth in popularity (Glaser & Risius, 2018). Participants make investments based upon information gathered in online communities. Copy trading within these communities allows participants in the network to replicate others' trades (Doering, Neumann, & Paul, 2015). Copy trading investors are split into two separate categories: signal providers and followers. Signal providers are individual investors whose investment decisions are available for followers to track and analyse. Followers are also individual investors; however, they copy the investment decisions of signal providers. Copy trading allows for instant and automated replication of signal provider trades by followers; therefore, this allows the delegation of the investment decision. Following signal providers allows followers to efficiently gather appropriate amounts of information in a cost-effective way. Essentially, by engaging in copy trading, investors avoid excessive analysis by

identifying their preferred signal providers and copying their trades (Oehler, Horn, & Wendt, 2016). This study builds a framework which models the intention of participants in social trading networks to engage in copy trading.

The framework is based on an analysis of literature, from different domains which discuss online trading, the growth of social trading networks, and the adoption of copy trading among retail investors (Barber & Odean, 2001b, 2002; Berger, Wenzel, & Wohlgemuth, 2018; Doering et al., 2015; Konana & Balasubramanian, 2005; Wohlgemuth et al., 2016). The framework created in this study is referred to as the Investor Engagement Framework (IEF). Monsuwé's, Dellaert's, and De Ruyter's (2004) research in online consumers' adoption of e-commerce describes perceived utilitarian gains as ease of use and usefulness and describes perceived hedonic gains as enjoyment. This study builds on existing research, such as Konana and Balasubramanian (2005), which suggests that satisfaction among online investors is largely driven by perceived utilitarian gains and perceived hedonic gains. The framework in this study similarly categorises ease of use and usefulness with utilitarian gains and categorises enjoyment with hedonic gains to extend Davis's (1989) Technology Acceptance Model (TAM) to the context of online investing. Analysing existing literature highlighted that the core constructs of TAM alone are, at times, not sufficient in modelling user acceptance (Pikkarainen et al., 2004). This study's framework extends existing research by including signal provider trustworthiness (Wohlgemuth et al., 2016) as an extension of TAM in the context of copy trading. Signal provider trustworthiness is included as an exogenous factor to mediate the relationships between TAM's core constructs and investors' intentions to engage in copy trading.

The next section of the chapter addresses the methodology used to review and analyse relevant literature. Following that, the framework is introduced containing constructs that impact online investors' attitudes and intentions to engage in copy trading. The chapter then describes usefulness, ease of use, and enjoyment as basic determinants of online investor intentions. The next section of the chapter describes how signal provider trustworthiness mediates the relationship between usefulness, ease of use, and enjoyment and the intentions of online investors to engage in copy trading. The final section of the chapter discusses the findings of the study, future research avenues, implications for researchers and implications for practitioners.

2.3. Literature review methodology

In order to complete a comprehensive literature review, this chapter followed the guidelines and instructions of Webster and Watson (2002). The review specifically focuses on literature in the field of copy trading. The review intends to propose a framework to accurately synthesize and extend the existing literature, shed light on avenues for future research, and ultimately provide practical implications within the area of copy trading. To fulfil this intention and provide a complete review of literature, concepts identified within existing literature are the focus of the study.

In order to identify the source material for the literature review, the major contributions from leading journals in the Information Systems field (generally referred to as the 'basket of eight' information systems journals) were examined. This basket consists of the European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems, and MIS Quarterly. Within these journals, the table of contents were reviewed to identify and highlight articles within the scope of copy trading. From there, literature and journals from outside the information systems field were also examined and highlighted as important due to the interconnected nature of information systems with other disciplines. Journals such as European Financial Management, Journal of Business Research, Review of Financial Studies, Decision Support Systems, International Journal of Service Industry Management and Journal of Decision Sciences were also examined. In addition to the examination of each journal's table of contents, academic databases were used to efficiently filter and identify relevant articles. Articles relating to copy trading from EBSCO, ProQuest, Science Direct, JSTOR and SSRN appeared most frequently from initial searches in Google Scholar and the Web of Science, therefore, these databases were primarily used to identify relevant articles.

Step 1: Investigation of leading journals and journal databases:

The first step in reviewing existing literature involved searching relevant, leading journals and journal databases (Melville, Kraemer, & Gurbaxani, 2004). The investigation of the basket of eight information systems journals used keywords to identify relevant articles (Hamari, Koivisto, & Sarsa, 2014). Searches were

conducted in titles and abstracts of papers using the following keywords: ‘online investing’, ‘online investors’, ‘online platforms’, ‘social trading’, ‘social influence in trading’ and ‘copy trading’. Following the search through titles and abstracts, each journal’s table of content was examined to identify any relevant research not identified by the initial keyword search.

This was followed by an extended search using the same keywords outside the basket of eight and information systems field of literature. Searches were also conducted in titles and abstracts of papers using the same keywords as previously used in the basket of eight search. Following the search through titles and abstracts, each journal’s table of content was examined as per Webster and Watson (2002) to identify any relevant research not identified by the initial keyword search. The additional search through these journals allowed for the identification of additional literature relevant to copy trading. By searching this additional layer of journals, literature was found that allowed the review to more holistically synthesize existing literature within the boundaries of this study.

In total, following the searches of the basket of eight information systems journals and relevant additional journals mentioned above, twelve articles were identified within the field of copy trading. These twelve articles included only one article from within the basket of eight Information Systems journals. A likely explanation for this is the relatively recent emergence of literature in the field of copy trading. The extended search for literature outside the basket of eight accounted for the other eleven relevant articles identified. Following the analysis of each article’s abstract, keywords, or the full article when necessary, three articles were deemed to be outside the scope of the research and were therefore excluded. The exclusion of these articles resulted in a total of nine articles deemed relevant for an in-depth review.

Step 2: Backward review:

During this step, the citations in the articles identified in step 1 were reviewed to identify prior studies in the field of copy trading. Within these citations, the keywords: ‘online investing’, ‘online investors’, ‘online platforms’, ‘social trading’, ‘social influence in trading’ and ‘copy trading’ were once again used to identify relevant articles. Reviewing the citations of articles from step 1 facilitated

the chronologically backwards investigation of articles within the scope of the review (Levy & Ellis, 2006). This identified the initial literature in the field of online investing and, more recently, copy trading. A further set of eighteen articles from journals and conference proceedings other than those formally searched were collected. Each of these articles was reviewed in full.

Step 3: Forward review:

The third and final step involved using the Web of Science and Google Scholar to identify studies that cite the key articles identified in steps 1 and 2. Articles identified were searched using the same keywords as step 1 for consistency. Reviewing the articles that cite those from step 1 and 2 facilitated the chronologically forward investigation of articles within the scope of the review (Levy & Ellis, 2006). This identified the more recent literature within the field of copy trading. A further set of seven articles from journals and conference proceedings other than those reviewed in steps 1 and 2 were identified. Each of these articles was reviewed in full. In total, the 3 steps resulted in the full review of a set of thirty-three articles.

As per Webster's and Watson's (2002) guidelines, a concept-centric matrix was created using concepts from all articles identified in each of the 3 steps. Articles were reviewed in full and corresponding concepts were grouped. Concepts were then segregated by unit of analysis to keep each concept relevant and within the scope of copy trading. Articles referenced were grouped by concept. An example of the concept-centric matrix used is seen below in Table 2-1, which illustrates usefulness as a concept derived from the review of existing literature in copy trading. The four articles referenced are grouped by the concept usefulness. This concept is then isolated by imitation, return on investment and risk management as units of analysis. Once new concepts were not being extracted during the review of relevant articles, the review was deemed to be nearing completion with a relatively complete account of the relevant literature (Webster & Watson, 2002). The table intends to convey key findings and relationships from existing literature.

Table 2-1: Concept-centric matrix

Concepts	Unit of analysis	Number of citations	Papers
Usefulness	Imitation	3	(Wohlgemuth et al., 2016), (Pan, Altshuler, & Pentland, 2012), (Berger et al., 2018).
	Risk management	4	(Berger et al., 2018), (Sharpe, 1964), (Markowitz, 1952), (Fama & MacBeth, 1973).
	Return on investment	10	(Barney, 1991), (Peteraf, 1993), (Berger et al., 2018), (Grahovac & Miller, 2009), (Jonsson & Regnér, 2009), (Madhok, Li, & Priem, 2010), (Barber & Odean, 2000), (Barber & Odean, 2001b), (Barber & Odean, 2002), (Konana & Balasubramanian, 2005).
Ease of use	Transparency	5	(Glaser & Risius, 2018), (Stoughton, 1993)
	Experience level	5	(Barber & Odean, 2002), (Konana & Balasubramanian, 2005), (Singh, Sandhu, & Kundu, 2010), (Pentland, 2013), (Berger et al., 2018).
	Reduced overtrading	9	(Barber & Odean, 2000), (Barber & Odean, 2001b), (Barber & Odean, 2001a), (Barber & Odean, 2002), (Choi et al., 2002) (Konana & Balasubramanian, 2005),

			(Anderson, 2007), (Berger et al., 2018), (Pelster, 2019).
	Reduced fees	6	(Barber & Odean, 2001b), (Konana & Balasubramanian, 2005), (Berger et al., 2018), (Glaser & Risius, 2018; Oehler et al., 2016), (Glaser & Risius, 2018), (Kromidha & Li, 2019).
Enjoyment	Self-attribution	4	(Konana & Balasubramanian, 2005), (Kahneman & Riepe, 1998), (Gervais & Odean, 2001), (Berger et al., 2018).
	Illusion of knowledge	4	(Konana & Balasubramanian, 2005) , (Barber & Odean, 2001b), (Barber & Odean, 2002), (Glaser & Risius, 2018).
	Illusion of control	3	(Langer, 1975), (Konana & Balasubramanian, 2005), (Barber & Odean, 2002), (Barber & Odean, 2001b).
Signal provider trustworthiness	Cognition-based signals	3	(McAllister, 1995), (Doering et al., 2015), (Wohlgemuth et al., 2016).
	Affect-based signals	4	(McAllister, 1995), (Pan et al., 2012), (Wohlgemuth et al., 2016), (Mesch, 2012).

Table 2-2: Literature review method summary

Systematic literature review summary			
Date Span	10/6/19 – 28/6/19		

<table>
<tr><th colspan="2">Step 1: Investigation of leading journals and journal databases:</th></tr>
<tr><td>Journals Chosen:</td><td>Reasoning:</td></tr>
<tr><td>European Journal of Information Systems
Information Systems Journal
Information Systems Research, Journal of AIS
Journal of Information Technology
Journal of MIS
Journal of Strategic Information Systems
MIS Quarterly</td><td>These journals are referred to as the ‘basket of eight’ information systems journals and are regarded as leading journals in the information systems (IS) field (Research - Association for Information Systems (AIS), 2020). Literature within these journals is used to accurately synthesize literature from the IS field within the scope of copy trading.</td></tr>
<tr><td>European Financial Management
Journal of Business Research
Review of Financial Studies
Decision Support Systems
International Journal of Service Industry Management
Journal of Decision Sciences</td><td>As the IS field is generally interconnected with other fields, literature and journals from other areas, such as financial services in this instance, were also examined and highlighted as relevant to copy trading.</td></tr>
<tr><td>Databases Chosen:</td><td>Reasoning:</td></tr>
<tr><td>EBSCO
ProQuest
Science Direct
JSTOR
SSRN</td><td>Google Scholar and the Web of Science were the search engines used initially in step 1 to look up the basket of eight IS journals. The selected databases were recurring when viewing articles and journal content. These databases were then used to proceed with steps 2 and 3 of the review.</td></tr>
<tr><td colspan="2">Method - Keyword Search:</td></tr>
<tr><td>Keywords used:
online investing
online investors
online platforms
social trading
social influence in trading
copy trading</td><td>Searched through:
Journal titles
Journal abstracts
Journal table of contents</td></tr>
<tr><td colspan="2">Results:</td></tr>
<tr><td colspan="2">A total of twelve articles related to copy trading, one within the Basket of eight IS journals, eleven outside the basket of eight IS journals.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Step 2: Backward review		
Method:		
• The citations from articles identified in step 1 were reviewed to identify prior studies in the field of copy trading. • Within these citations, the same keywords used in step 1 were used to search through article titles and abstracts.		
Results:		
• A further set of eighteen relevant articles.		
Step 3: Forward review		
Method:		
• The studies that cited articles identified in step 1 and step 2 were reviewed to identify more recent studies the field of copy trading. • Within these studies, the same keywords used in step 1 were used to search through article titles and abstracts. • Google Scholar and the Web of Science were used to carry out step 3.		
Results:		
• A further set of thirty-three relevant articles.		
Concept-centric matrix		
Concept	Unit of analysis	Number of citations
Usefulness	Imitation	3
	Risk management	4
	Return on investment	10
Ease of use	Transparency	5
	Experience level	5
	Reduced overtrading	9
	Reduced fees	6
Enjoyment	Self-attribution	4
	Illusion of knowledge	4
	Illusion of control	3
Signal provider trustworthiness	Cognition-based signals	3
	Affect-based signals	4

2.4. Investor Engagement Framework core constructs

This study's framework intends to illustrate online investors' intention to engage in copy trading through the lens of previous research on consumer adoption of new technologies. As described above, the core constructs of the framework are adapted from TAM (Davis, 1989). While TAM has been used generally as a method to gauge a user's willingness to accept emerging technology, previous literature has validated TAM as a predictor of technology adoption in the context of online investing (Balasubramanian, Konana, & Menon, 2003; Konana &

Balasubramanian, 2005). Therefore, TAM constructs are considered to be appropriate as an initial basis for this study's framework.

TAM identifies two determinants, according to previous research, that play an important role in people's acceptance or rejection of information technology. The first determinant referred to as perceived usefulness, describes how people tend to use or not use an application to the extent that they believe it will help them improve performance. The second determinant referred to as perceived ease of use describes how an application that is easy to use is more likely to be accepted. Therefore, in addition to perceived usefulness, usage is theorized to be influenced by perceived ease of use. To align the core constructs of this study's framework with the core constructs of TAM, perceived usefulness is defined as the degree to which a person believes that using copy trading would enhance their online trading performance. Similarly perceived ease of use is defined as the degree to which a person believes engaging in copy trading would be free of effort. Davis, Bagozzi, and Warshaw (1992) extend TAM with enjoyment as an additional basic determinant of technology user acceptance. This study's framework includes enjoyment as a core construct as per this more recent version of TAM. During the study, enjoyment is defined as the extent to which copy trading provides satisfaction among investors, despite any negative impacts on investment performance. In summary, the three basic determinants of user acceptance within this study's framework are perceived usefulness, perceived ease of use and enjoyment. Throughout this chapter, these basic determinants will be referred to as the core constructs of the framework. Therefore, in a similar fashion to prior research based on online technology adoption (Konana & Balasubramanian, 2005; Monsuwé et al., 2004), this study's framework includes both utilitarian and hedonic basic determinants of investors' attitude towards copy trading. TAM core constructs are illustrated below in Figure 2-1. The next section of the chapter extends TAM by examining each core construct and identifying the corresponding underlying drivers in the context of copy trading.

2.5. Underlying drivers of core constructs

This section of the chapter intends to discuss copy trading through the lens of TAM's core constructs of usefulness, ease of use and enjoyment. Each core construct is defined, applied to the context of a certain system and broken down into separate subcomponents referred to as underlying drivers of the core construct.

While TAM and its core constructs are generally applied to user acceptance of emerging technology, this study considers TAM's core constructs as determinants of investors' adoption of copy trading. The following sections address each core construct and the corresponding underlying drivers in this context.

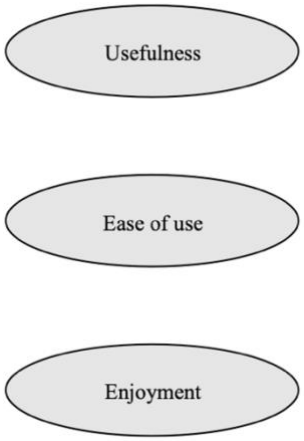


Figure 2-1: The core constructs of TAM

2.5.1. Usefulness

Perceived usefulness, as identified by TAM, plays an important role in a user's acceptance or rejection of new technology. Davis (1989) describes perceived usefulness as the extent to which people believe technology "will help them perform their job better" (p. 320). In the context of this study usefulness is defined as the degree to which an investor believes that by engaging in copy trading, they will improve their investment performance and outcomes. In this study's framework, three underlying drivers of the usefulness construct are identified as: imitation, return on investment and risk management, as illustrated by Figure 2-2. The framework refers to these underlying drivers as key characteristics of usefulness in copy trading, each is explained separately below.

Imitation is facilitated by the copy trading functionality of social trading networks. Copy trading refers to "automatically, simultaneously, and unconditionally replicate other investors' trades" (Wohlgemuth et al., 2016, p. 1). This feature enables investors to imitate more experienced and competent investors and benefit from more profitable opportunities (Pan et al., 2012). Copy trading also allows for investors to bypass typical transactional costs and costs in gathering information, thus making it very attractive and practical for less-experienced traders. By engaging in copy trading, inexperienced investors can imitate other more

experienced investors to realise higher returns from the beginning and subsequently develop knowledge and expertise (Berger et al., 2018). Enhancing investors' profitability through imitation aligns with the framework's definition of perceived usefulness in that imitation allows investors to enhance returns.

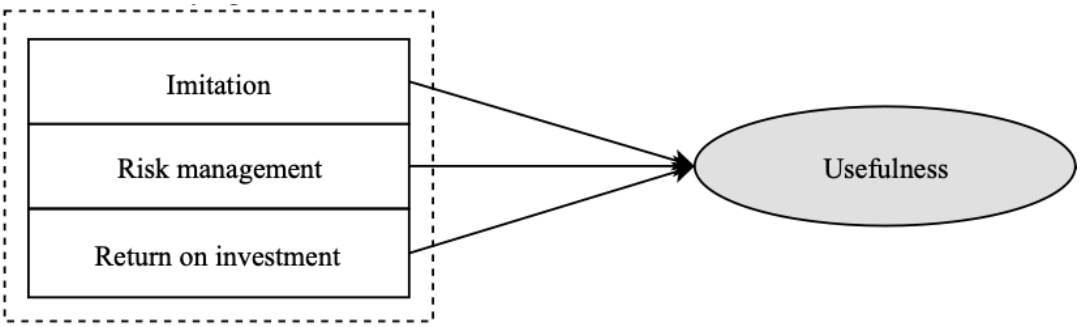


Figure 2-2: Usefulness underlying drivers

Risk management in copy trading is highlighted by Berger et al. (2018) as playing a primary role in explaining performance outcomes. In investment contexts, risk refers to the potential for deviation of returns from expected outcomes (Sharpe, 1964). Previous literature identifies diversification as a primary method of investment risk mitigation (Markowitz, 1952). In tailoring a portfolio to a particular risk appetite, investors' decisions are considered to be influenced by the risk-return trade-off of a particular investment (Fama & MacBeth, 1973). Berger et al. (2018) describe how investors can build portfolios diversified by imitated investors in accordance with their own objectives and risk appetite. Signal providers are assigned a risk score by the social trading platform to portray their risk exposure to imitators. Imitators can then choose to imitate signal providers with risk scores aligning with their own preferences. The research of Berger et al. (2018) solidifies the idea that by identifying signal providers with similar risk appetites, followers can achieve improved returns via imitation. Therefore, risk management in a copy trading context aligns with the framework's definition of usefulness as the investor believes that copy trading could improve risk management via the diversification of signal providers, enhancing portfolio performance.

Return on investments in copy trading is primarily influenced by the resource-based view as described by Berger et al. (2018). Barney's (1991) and Peteraf's (1993) resource-based view suggests that uniqueness among firms allows for "sustained competitive advantage" (p. 1). Their research also points out that inimitable resources are likely to produce increased returns; therefore, if competitors can

imitate these resources, equally improved returns are realised. Existing literature also points out the significant cost of emulating and rearranging resources as barriers to imitation (Jonsson & Regnér, 2009). In the context of copy trading platforms, inexperienced investors can undermine these barriers to imitation by avoiding typical transactional costs and costs in gathering information when imitating more experienced investors' trades. Early research in online investing discusses how overtrading causes online investors to underperform more traditional investment strategies (Barber & Odean, 2000, 2001b, 2002; Konana & Balasubramanian, 2005). Copy trading offers a solution to these inexperienced online investors by neutralising their lack of experience via imitation and realising returns comparable to those of more competent investors (Berger et al., 2018). This aligns with the framework's definition of usefulness in that by engaging in copy trading, investors can enhance their returns.

In summary imitation, risk management and return on investment are enhanced by copy trading according to previous literature. This study's framework defines usefulness as the degree to which an online investor can enhance their investment performance. By incorporating the analysis of existing literature on online investing and copy trading, the framework suggests that imitation, risk management and return on investments are the foundational underlying drivers of perceived usefulness among investors in copy trading.

2.5.2. Ease of use

Perceived ease of use, as identified by TAM, plays an important role in a user's acceptance or rejection of new technology and is defined in this study as the ease with which investors can copy trades and realise improved returns. In this study's framework, four underlying dimensions of the ease of use core construct are identified and included: transparency (Glaser & Risius, 2018), experience level (Balasubramanian et al., 2003; Berger et al., 2018), reduced overtrading (Anderson, 2006; Barber & Odean, 2000; Choi et al., 2002) and reduced fees (Barber & Odean, 2001b; Berger et al., 2018; Glaser & Risius, 2018; Konana & Balasubramanian, 2005; Kromidha & Li, 2019; Oehler et al., 2016) as illustrated by Figure 2-3. The framework refers to these underlying drivers as key characteristics of ease of use in online copy trading; each is described separately below.

Transparent social trading networks are becoming increasingly relevant as disintermediating platforms. Signal provider transparency in these networks combined with automated and immediate replication of their decisions allows for extensive control over investments (Glaser & Risius, 2018). The study of Stoughton (1993) highlights the bias of investment managers in prioritising their own profits over the underlying investor. A fundamental difference to investment manager-underlying investor relationship in social trading is the degree of transparency regarding signal provider decisions. In traditional delegated portfolio management, investors receive periodic updates on returns. Social trading in comparison is fully transparent in that investors can see every decision made by signal providers. Due to the visibility of signal provider performance, followers can identify more competent investors with more conservative approaches, thus increasing the followers chance of improved returns (Glaser & Risius, 2018). The degree of transparency in social trading platforms allows investors to easily choose a signal provider based on the information available, thus aligning with the framework's core construct ease of use.

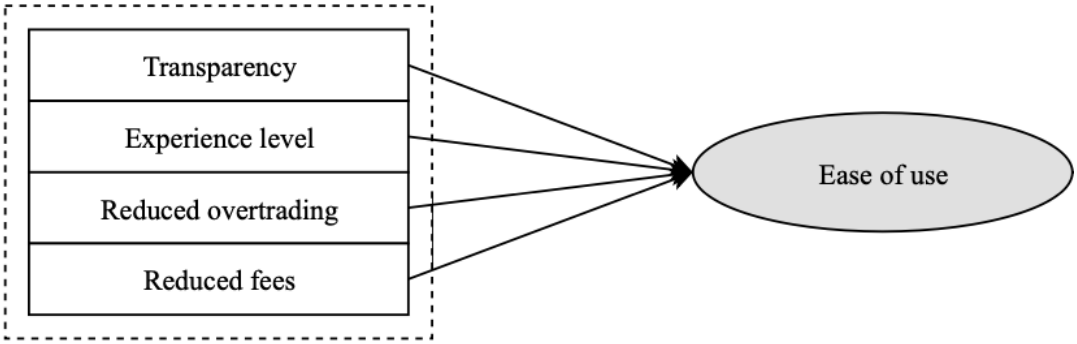


Figure 2-3: Ease of use underlying drivers

In terms of online investors' experience level, Barber and Odean (2002) point out that the democratization of information online means investors have access to data similar to investment professionals; however, a clear disparity with regard to experience level exists. Their study goes on to point out that the more overconfident an investor is, the more likely they are to overstate their experience level and ultimately the more likely they are to begin investing online. Overconfidence is then highlighted among these online investors who trade excessively resulting in sub-par returns. The study ultimately suggests that rational investors would not engage in overtrading. Konana and Balasubramanian (2005) describe how, traditionally,

competent brokers with superior knowledge are used to manage investments. Their study also identifies that overconfidence is evident among inexperienced investors; however, this overconfidence is corrected by experience. The work of Singh et al. (2010) highlights a disparity in experience level between adopters and non-adopters of investing online. However, the study goes on to identify that younger investors value information obtained online more than older, more experienced, investors. Ultimately, the study finds that inexperienced investors are more likely to adopt online investing. Existing research after the emergence of copy trading, such as Pentland (2013)'s study of the social trading platform eToro, reveals that followers who imitate investors with diversified portfolios can achieve higher returns. This finding highlights that imitation can allow average or inexperienced investors to realise improved and in some cases above-average returns. Berger et al. (2018) further consolidate this finding by presenting empirical evidence that inexperienced investors can achieve returns comparable to those of experienced investors. Therefore the disparity in experience levels among online investors identified by Barber and Odean (2002), Konana and Balasubramanian (2005) and Singh et al. (2010) is somewhat bridged by copy trading and improved returns are realised with relatively lower levels of effort aligning with this framework's core construct of usefulness.

Overtrading as described above is a destructive attribute of overconfident online investors who trade excessively and therefore reduce returns (Anderson, 2007; Barber & Odean, 2000, 2001a, 2001b, 2002; Choi et al., 2002; Konana & Balasubramanian, 2005). Online investing reduces traditional costs associated with liquidity, transactions and commissions. However, Barber and Odean (2002) identify that increased speculation among investors online offsets these cost reductions. These speculative losses are a result of overconfident, irrational, investors. Copy trading has the potential to neutralise this irrationality. This is pointed out by the research of Berger et al. (2018) who propose that less competent, excessive traders can imitate more rational and competent traders, resulting in improved returns. The findings of Pelster (2019) highlight attention from peers and an increase in followers results in an increase in trading volumes; however, these volumes decrease in time. In summary, by identifying rational and more competent investors, less rational and less competent investors can delegate their decisions to

signal providers and to a certain extent, reduce irrational overtrading. This reduction in irrational overtrading via copy trading requires a lower level of effort from investors to realise higher returns, aligning with this framework's core construct, usefulness.

Reduced fees are pointed out in early online investing literature by Barber and Odean (2001b) and Konana and Balasubramanian (2005) as a benefit for investors using disintermediated online platforms that significantly reduce the cost of executing trades and gathering investment information. However, overtrading stems partially from these reduced costs which, while lower per transaction, can accumulate with increased trading volume (Barber & Odean, 2001a). Copy trading has been identified as a method for less competent investors to imitate more rational investors and, therefore, reduce irrational overtrading (Berger et al., 2018) and reduce costs accumulated from increased trading volume. In combination with rational trading volumes reducing costs, recent literature focusing on copy trading highlights cost efficiency with regard to transactions and acquiring information via copy trading (Glaser & Risius, 2018; Oehler et al., 2016). This observation is reiterated by Berger et al. (2018) who point out that costs in transacting and gathering information are incurred by the signal provider, not the follower. Kromidha and Li (2019) highlight the low cost of choosing between alternative signal providers. Generally, copy trading has proven to be cost-effective and free of significant effort relative to traditional investing. This aligns with the framework's core construct of usefulness.

In summary, based on an analysis of previous literature, copy trading's increased transparency, reduction of fees and reduction of overtrading among inexperienced investors allows for an investing experience that generally requires less effort than traditional methods. This study's framework defines ease of use as the ease with which investors can copy trades and realise improved returns as per TAM. By incorporating the analysis of existing literature on online investing and copy trading, the framework posits that transparency, experience level, reduced overtrading and reduced fees are the foundational underlying drivers of perceived ease of use among investors in copy trading.

2.5.3. Enjoyment

Enjoyment is an extension of TAM identified by Davis et al. (1992) which acts as an additional basic determinant of a user's acceptance or rejection of new technology. Enjoyment is defined during this study as the extent to which social trading provides satisfaction among investors, despite any negative impacts on investment performance. In this study's framework, three underlying dimensions of the enjoyment core construct are identified and included: self-attribution, illusion of knowledge, and illusion of control (Anderson, 2006; Barber & Odean, 2000, 2001b, 2002; Konana & Balasubramanian, 2005; Looney, Valacich, Todd, & Morris, 2006; Uchida, 2006; Unsal & Movassaghi, 2001) as illustrated by Figure 2-4. The framework refers to these underlying drivers as key characteristics of enjoyment for online social trading. Each is described separately below.

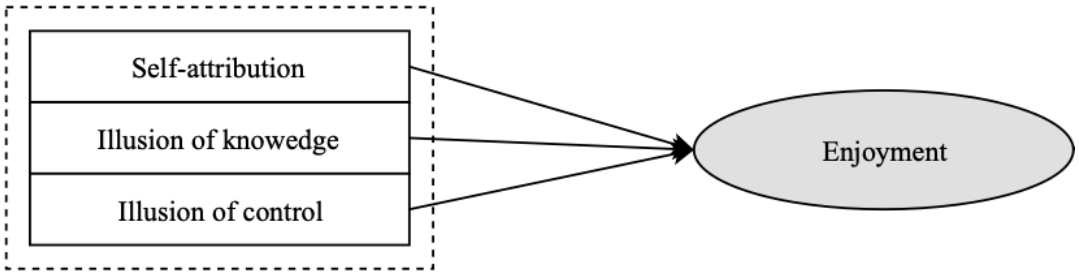


Figure 2-4: Enjoyment underlying drivers

Self-attribution is evident when investors attribute decisions with positive outcomes to themselves, and negative outcomes elsewhere (Konana & Balasubramanian, 2005). The applicability of self-attribution to online investing is particularly evident with investors using traditional brokers. The perceived competence and experience levels of brokers result in an assumption among investors that broker decisions are well informed (Kahneman & Riepe, 1998). Volatility in financial markets can result in undesirable broker decisions; in this case, self-attribution is evident when investors assign the responsibility of their losses to a broker (Konana & Balasubramanian, 2005). Gervais and Odean (2001) find that investors often relate their own insights to increased returns and as a result recognise failures less and overemphasise successes. Konana and Balasubramanian (2005) go on to point out that investors exaggerate the quality of their own decisions due to the vast amount of information available online. Ultimately this allows for investors to overemphasise decisions with positive outcomes and relieve decisions with negative outcomes. Their study goes on to highlight that overconfident investors,

subject to self-attribution, will be satisfied with a lower return. Berger et al. (2018) describe how by imitating signal providers in copy trading, investors can delegate investment decisions to more experienced or more competent investors. Therefore, the investor's decision shifts from being between trades to between signal providers. Considering the decision made by followers between signal providers ultimately results in either positive or negative financial returns, self-attribution can be applied to the context of copy trading. Investors can associate successful investment outcomes with their own choice of signal provider and can associate unsuccessful investment outcomes with the decisions of the signal providers they follow. Overconfidence stemming from self-attribution ultimately derives greater satisfaction for investors (Konana & Balasubramanian, 2005), aligning with the framework's core construct of enjoyment.

The illusion of knowledge is referred to by Konana and Balasubramanian (2005) as an investor's excessive perception of their own competence and expertise. This stems from the study of Barber and Odean (2001b) who suggest that online investors have access to far more information than previously, often in disintermediated environments. The proposition that the volume of information available correlates with increased knowledge and better decision-making appeals to investors. However, the relevance of the information and the ability of the investor to use the information is more important. Therefore, a greater volume and variety of information is likely to feed the illusion of knowledge and ultimately promote overconfidence (Barber & Odean, 2002). With regard to information in copy trading, Glaser and Risius (2018) highlight the high degree of transparency for investors. When engaging in copy trading, investors have "real-time resolution control" over their invested capital and full visibility over signal provider trading decisions along with the wealth of financial information provided online outside social trading platforms (p. 2). Due to this volume of information available on social trading platforms, it is reasonable to assume that online investors' illusion of knowledge does not deteriorate in the context of copy trading. Konana and Balasubramanian (2005) associate investors' satisfaction levels with the illusion of knowledge, again aligning with this framework's core construct of enjoyment.

The illusion of control is defined by Langer (1975) as an excessively high "expectancy of personal success" (p. 3). Essentially, the illusion of control in copy

trading is observed when an investor overestimates their ability to control an investment outcome (Konana & Balasubramanian, 2005). In the online investing domain, Barber and Odean (2002) have identified involvement as a catalyst for the illusion of control among online investors. In a survey, their study observed that one of the main reasons investors began trading online was due to a feeling of empowerment. Barber and Odean (2001b) highlight that online investors are likely to trade excessively and speculatively as a result of the illusion of control when making investments, ultimately decreasing returns. Konana and Balasubramanian (2005) describe how the illusion of control among investors results in overconfident trading, consistent with the findings of Barber and Odean (2001b). In the context of copy trading, control among followers can be transferred from choosing between trades to choosing between signal providers via copy trading. As such, control in the traditional sense of online investing remains however trades are executed by signal providers via imitation (Berger et al., 2018). Konana and Balasubramanian (2005) identify that the illusion of control among online investors results in overconfident trading and increased self-attribution, ultimately deriving satisfaction for investors, aligning with this framework's core construct of enjoyment.

In summary, according to previous literature, self-attribution among participants in copy trading, combined with an illusion of knowledge and an illusion of control provides satisfaction for investors. This study's framework defines enjoyment as the extent to which the activity of using a new application is perceived to provide reinforcement, apart from any performance consequences that may be anticipated as per TAM. By incorporating the analysis of existing literature on online investing and copy trading, the framework suggests that self-attribution, the illusion of knowledge and illusion of control are the foundational underlying drivers of enjoyment among investors in copy trading.

2.6. Signal provider trustworthiness

Usefulness, ease of use and enjoyment were adapted from TAM (Davis, 1989, 1993) as the core constructs for this research's framework. These core constructs, as per TAM, are considered basic determinants of a user's acceptance or rejection of a new technology. While these constructs and their underlying drivers illustrate to a certain extent why an online investor would engage in copy trading, the framework suggests that the TAM core constructs alone aren't enough to engage

online investors. Previous literature has identified that for TAM to accurately reflect a user's acceptance of certain technology, additional factors of acceptance must be considered (Pikkarainen et al., 2004). This study considers signal provider trustworthiness as a mediator for the relationship between TAM's core constructs and an online investor's intention to engage in copy trading. By adding signal provider trustworthiness as a core construct, the framework is refined specifically to the context of copy trading. Therefore, signal provider trustworthiness and its subcomponents, cognition-based signals and affect-based signals, are added to TAM's core constructs to model investors' intention to engage in copy trading; Figure *2-5* illustrates this.

Existing literature has identified the importance of signalling trustworthiness, in a variety of contexts in online communities, to overcome the difficulties of developing trust online (O'Sullivan, 2015; Pagani, Hofacker, & Goldsmith, 2011; Shankar, Urban, & Sultan, 2002; Yousafzai, Pallister, & Foxall, 2005). While trust online has been highlighted and researched in varying contexts, the work of Wohlgemuth et al. (2016) highlight the importance of signalling trustworthiness specifically within social trading networks. Their research describes how trustworthiness plays a particularly relevant and important role in the context of copy trading. Copy trading allows investors to directly imitate a signal provider's financial decisions and, by copying these decisions without evaluation beforehand, investors must trust these signal providers. Considering the financial responsibility of each decision within social trading networks, trust and signal provider trustworthiness plays a particularly significant role. Pan et al. (2012) also point out that the lack of offline interaction in copy trading means investors solely rely on signals sent by other participants in social trading networks; therefore, the trustworthiness of signal providers is critical.

McAllister (1995) examines interpersonal trust among managers and professionals in organisations. The study found that trust is both cognition-based and affect-based. Previous literature describes how cognition-based trust is a result of good reasons for trust such as reliability, dependency and competency (Lewis & Weigert, 1985). Affect-based trust is described as a result of interpersonal, emotional connections (McAllister, 1995). Cognition-based and affect-based trust has since been applied to the interpersonal trust of investors engaging in copy trading

(Wohlgemuth et al., 2016). The complex nature of financial trading requires cognition-based signals of trustworthiness to establish trust among participants in copy trading. The integration of social networks in social trading platforms means affect-based signals are also required to establish trust between signal providers and participants. Neither cognition-based nor affect-based signals on their own are deemed enough to establish trust between signal providers and followers. Trust, therefore, is modelled in the context of copy trading as a combination of cognition-based signals and affect-based signals from the signal provider. This model is conceptualised and tested in Wohlgemuth et al. (2016)'s study of signal provider trustworthiness on the social trading network eToro.

2.6.1. Cognition-based signals of trustworthiness

Cognition-based signals of trustworthiness indicate the technical competence of a trusted individual in a specific field or for a specific task. In the context of copy trading, the domain-specific task and indicator of technical competence are referred to as the identification and execution of profitable investment decisions (Doering et al., 2015).

In Wohlgemuth et al. (2016)'s study, four cognition-based signals of trustworthiness were identified. The first signal was *profitable trades*, referring to the number of trades with positive outcomes. The second cognition-based signal of trustworthiness was *return*, referring to the annual return on investment. The third cognition-based signal of trustworthiness was *maximum drawdown*, referring to an investor's greatest loss over the course of one week as a percentage of the account's balance. The fourth cognition-based signal of trustworthiness was *risk level*, referring to the risk appetite of the signal provider in question. These four cognition-based signals of trustworthiness provide a detailed picture of the signal provider's trustworthiness.

2.6.2. Affect-based signals of trustworthiness

Affect-based signals of trustworthiness indicate that a trusted individual shares similar values with the trustor (McAllister, 1995). The social component of affect-based signalling complements the technical cognition-based signals of trust. A differentiating factor between cognition-based and affect-based signals of trustworthiness is the ability to transfer affect-based signals between tasks. As a

result, affect-based signals of trustworthiness generate interpersonal trust as a result of demonstrating social competence (Pan et al., 2012). Examples of these include full name, personal pictures, number of followers, and previous performance.

In Wohlgemuth et al. (2016)'s study, two affect-based signals of trustworthiness were identified. Building on the study of McAllister (1995), the first two affect-based signals were derived from "citizenship behaviour"; in the context of social trading (p. 30). This refers to the behaviour of participants with the intention of "effective community functioning not directly resulting from self-interest or reward-seeking behaviour" (Wohlgemuth et al., 2016, p. 3). In the study, the disclosure of both a personal picture and full name, in addition to a username, were affect-based signals of trustworthiness and enough to portray a signal provider's identity to followers. This aligns with the findings of Mesch (2012), who associate the disclosure of personally identifiable information with online trust. The second indicator of affect-based signals of trustworthiness was interaction frequency (Wohlgemuth et al., 2016). In the context of copy trading, interaction frequency referred to the trading frequency of members in the online community. This signal was quantified by identifying a trader's number of active days on the investment platform.

The results of Wohlgemuth et al. (2016) highlight the complementary nature of cognition-based signals and affect-based signals in establishing trust and prompting decisions among followers in the context of copy trading. Specifically, in terms of signalling, the results of their study illustrate that *profitable trades*, *return* and *maximum drawdown* are cognition-based signals. In conjunction with these is the presence of a picture, full name and interaction frequency, which are affect-based signals enabling followers to establish trust in signal providers.

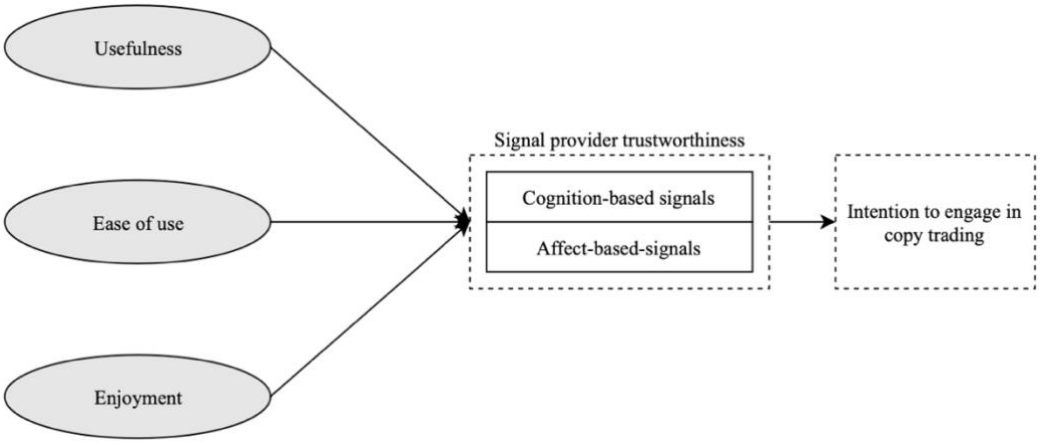


Figure 2-5: Signal provider trustworthiness as a mediator.

In summary, financial performance matters when establishing trust among followers, however signal providers must also demonstrate each appropriate affect-based signal. Followers do not rely on the cognition-based signal, *risk level*, to establish trust. Wohlgemuth et al. (2016) refer to the risk-return trade-off associated with trading and corresponding follower preferences as a plausible explanation for this finding. Their findings also highlight the importance of trustors preferences in establishing trust.

2.7. Investor Engagement Framework discussion

This study's framework intends to model online investors' intention to engage in copy trading; this is illustrated in full in Figure 2-6. Three of the framework's core constructs are derived from TAM: usefulness; ease of use; and enjoyment. These core constructs are used as a basis to examine investor intentions to engage in copy trading. To contextualise the constructs, features of copy trading are identified as underlying drivers of each core construct. Firstly, the framework identifies that imitation, risk management and return on investment are deemed to enhance investor performance, therefore, increase the perceived usefulness of copy trading. This suggests that for investors to engage in copy trading, it must be emphasised and clear that financial performance will be increased. Secondly, the framework highlights that transparency, experience level, reduced overtrading and reduced fees drive perceived ease of use. This suggests that copy trading appeals more to investors when it is perceived to be free of effort. Thirdly, the framework suggests that self-attribution, the illusion of knowledge and illusion of control make copy trading more enjoyable for investors regardless of the investment outcome.

Finally, the framework includes signal provider trustworthiness as an additional core construct which mediates the relationship between TAM's core constructs and an investor's intention to engage in copy trading. The inclusion of signal provider trustworthiness builds on TAM's core constructs in the specific context of copy trading. This trustworthiness is broken down into two separate forms of signalling, cognition based-signalling and affect-based signalling. The framework suggests

that when delivered effectively, cognition-based signals and affect-based signals of trustworthiness form the trust necessary for investors to engage in copy trading.

While usefulness, ease of use, enjoyment and signal provider trustworthiness are highlighted individually as core constructs of investor engagement in copy trading, the framework's overall contribution is that the core constructs and their underlying drivers must work interdependently. It is considered that an investor's intention to engage in copy trading is nullified when any of the core constructs or their underlying drivers are absent.

2.8. Implications for practitioners and researchers

The framework proposed in this study ultimately details the copy trading features that specifically attract investors and build trust. These details primarily benefit practitioners. Understanding what impacts trust among investors in copy trading is important in the development of strategic and technological advancements to increase investor satisfaction and outcomes. The framework suggests that platform providers and marketers should identify and emphasise the features that users find easy to use, benefit from and enjoy, for example, increased returns as a result of copy trading. Finally, the framework shows that platform and signal providers must emphasise the availability of signal providers' personal information and performance information to build trust with investors.

A further benefit of this chapter's framework is in helping researchers understand the drivers of online investors to engage in copy trading and delegate their investment decisions to others online. The framework is based upon TAM's core constructs; however, this chapter extends TAM with the introduction of signal provider trustworthiness as an exogenous factor and by identifying drivers of the core constructs. Signal provider trustworthiness mediates the relationship between investors' decisions to engage in copy trading and TAM's core constructs of user acceptance. Therefore, the framework emphasises the importance of building trust between participants in copy trading. While the framework discusses each of the core constructs and their corresponding underlying drivers, it does not rank or weigh the constructs and drivers in terms of relevance or importance. To further understand what drives user acceptance of copy trading, future research could explore which specific features of this framework have the most significant effect

on user intentions to engage in copy trading and intentions to delegate investment decisions to others. While objectives generally vary from investor to investor, an attempt could be made to filter out less significant factors in engaging in copy trading to further refine the framework presented in this study.

2.9. Conclusion

Existing research on copy trading identifies individual features that drive its growing popularity. This chapter proposes a conceptual framework to accurately synthesize and extend this existing literature. Firstly, the chapter identifies that TAM's core constructs must be extended when applied to the context of copy trading engagement. Trust is considered paramount in investment decisions, particularly when the decision is influenced by others. As a result of this, signal provider trustworthiness is identified as an appropriate core construct to extend TAM. In total, perceived usefulness, perceived ease of use, enjoyment and signal provider trustworthiness make up the framework's core constructs. Finally, the overall contribution of the framework proposed in this study is that the combination of perceived usefulness, ease of use, enjoyment and signal provider trustworthiness drive investor engagement in copy trading.

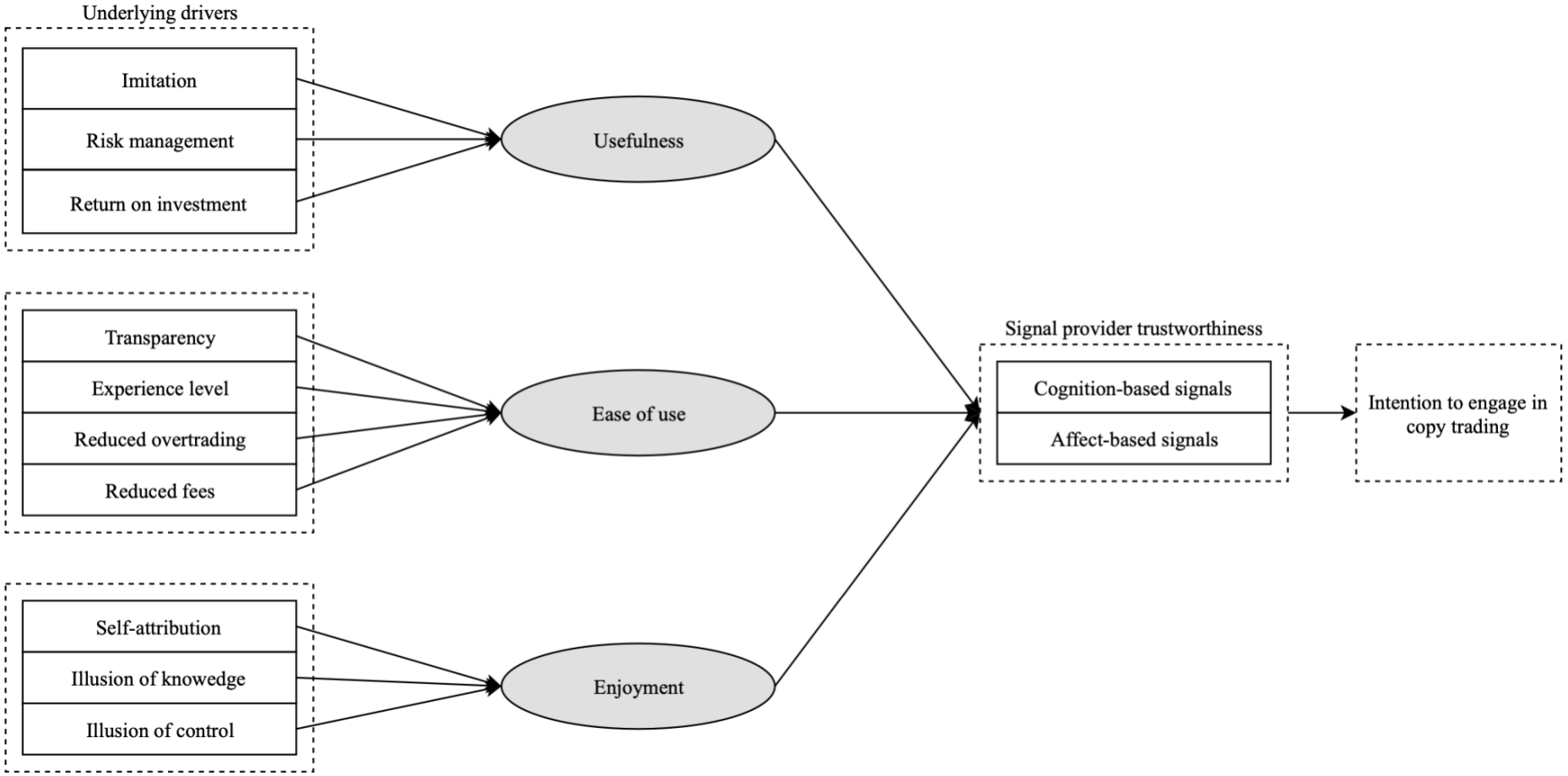


Figure 2-6: Full IEF modelling investors' intention to engage in social trading.

Chapter 3. Social media and online investing: An investigation of overconfidence.

3.1. Abstract

This study examines how online investor overconfidence is impacted by social media usage. A concept-centric review of existing literature is used to identify core themes and extract relevant interview questions to examine online investor overconfidence and social media usage. Semi-structured, qualitative interviews were then conducted with online investors to gather data on overconfidence and social media usage. The study reveals a higher level of overconfidence among investors who use social media to gather investment opinions and imitate investment decisions. Results also suggest that cryptocurrency investors rely more heavily on social media than online stock market investors, when gathering investment-related information. These findings reveal that online investor overconfidence is enhanced when social media is used to inform investment decisions.

3.2. Introduction

Previous literature describes how investor decisions are influenced by the opinions of others. Prior to online communication, those living in the same location influenced each other when making investment decisions. Hong, Kubik, and Stein (2005) explored how investors traditionally used "word-of-mouth communication" to spread their thoughts and opinions of stocks to peers and their study found that investors from the same city would influence each other (p.1). Similarly, at a lower level, Ivković and Weisbenner (2007) explored the investment choices of peers within a certain neighbourhood which revealed that peers within the neighbourhood are influenced by each other's decisions. This corroborates the findings of Hong et al. (2005), by showing that investors who are close geographically are exposed to each other's investment opinions, thus, impacting their own decisions.

Other literature examines the word-of-mouth effect in online communities. This is illustrated by both the growing pool of literature addressing the topic and the growth of online social trading platforms such as eToro discussed in Chapter 2. Agarwal, Kumar, and Goel (2019) describe how online stock message boards are followed closely by investors, as they provide exposure to the opinions of others about the stock market. Early literature by Wysocki (1998) tested the relationship between the

variation in posting volume on Yahoo! and corresponding stock market activity. Findings suggest that daily posting volume corresponds with movements in trade volume and returns. The study also found that an increase in the volume of posting overnight predicts changes in trading volume the next day. Antweiler and Frank (2004) corroborated these findings by identifying that the volume and variety of opinions expressed on stock market message boards such as Yahoo! Finance and RagingBull.com can also be used to predict subsequent trading volume. Chen, De, Hu, and Hwang (2014) also found that opinions revealed on SeekingAlpha.com, a social networking site specifically for investors, could be used to predict future stock market movements. Phillips's and Gorse's (2017) research highlights Reddit as a valuable source of information for cryptocurrency investors by identifying a correlation between the volume of posts on Reddit and corresponding movements in cryptocurrency prices. This literature provides evidence of the word-of-mouth effect online and highlights investors' use of online communities to directly gather the opinions of others.

So, while word of mouth effect demonstrates how online investors tend to base their investment decisions on others' opinions online, overconfidence, as a result of this tendency is a new area to be researched. Initially, the behaviour of online investors was examined by Barber and Odean (2002) who identified overconfidence as a result of the self-attribution bias, the illusion of knowledge, and the illusion of control. Barber and Odean (2002) define the self-attribution bias as an investor's attribution of "their success to their own abilities, even when such attribution is unwarranted" (p. 3). They describe the illusion of knowledge as increased investor overconfidence "when given more information on which to base a forecast". Finally, they describe the illusion of control as to when online investors "behave as if their personal involvement can influence the outcome of chance events". While these characteristics of overconfidence have since been corroborated (Barber & Odean, 2001a, 2001b, 2002; Gervais & Odean, 2001; Konana & Balasubramanian, 2005), they have yet to be explored in the context of social media usage. This study's objective is to examine how online investor overconfidence is impacted by social media usage. Overconfidence among investors who use social media is examined through the lens of the self-attribution bias, illusion of knowledge, and illusion of control.

The next section of the chapter discusses the methodology used to gather and synthesize existing literature. Following this, the chapter discusses literature in the field of online investor overconfidence and social media usage in order to derive relevant interview questions. The chapter then proceeds to describe the interview process used to gather data for analysis. The results from the analysis of these interviews are then presented. Finally, the study concludes with implications for practitioners and implications for further research.

3.3. Literature review methodology

While reviewing existing literature on online investing, online investor overconfidence and the use of social media by investors, this study followed the guidelines of Webster and Watson (2002), as described in detail in Chapter 2. The concept-centric review is used to holistically synthesize recurring findings, highlight directions for research, define the scope of the study and refine the study's objectives (Webster and Watson, 2002). The review derives concepts by combining findings from existing literature. By analysing these concepts, a set of relevant questions are generated for interviews exploring online investor overconfidence in their use of social media to gather and imitate others' investment-related opinions and decisions.

Information systems is the field of research primarily explored during this literature review. To explore existing information systems literature, major contributions from the 'basket of eight' journals were examined. The table of contents for each journal was reviewed in order to reveal articles within the scope of online investor overconfidence and social media usage. The overlap between information systems literature and investor behaviour literature resulted in the additional exploration of journals from outside the information systems field. Again, the table of contents for each additional journal identified was reviewed to reveal articles within the scope of online investor overconfidence and social media usage. Following the examination of each journal's table of contents, academic databases were used to further identify relevant literature for review.

As described in Chapter 2, existing literature was reviewed during 3 separate steps. Firstly, the keyword search of journals and academic databases, followed by the backward review, then the forward review of existing literature. In total, fifty-four relevant articles were identified and reviewed in full.

As per the guidelines of Webster and Watson (2002), a concept-centric matrix was created from concepts identified during a full review of articles. In order to keep each concept relevant and within the scope of online investor overconfidence and social media usage, concepts were isolated by unit of analysis. Following this, the articles referenced were grouped by concept. Table 3-1 below, shows the concept-centric matrix. Overconfidence is illustrated as a concept derived from the review of existing literature. This concept is then isolated by the self-attribution bias, the illusion of knowledge, and the illusion of control as units of analysis. The review was completed once new concepts were not identified during the review of relevant articles. The purpose of the concept-centric matrix was to synthesize existing literature (Webster & Watson, 2002) and, from there, questions for interviews are derived.

Table 3-1: Concept-centric matrix

Concepts	**Unit of analysis**	**Number of citations**	**References**
Overconfidence	Self-attribution bias	3	(Barber & Odean, 2002; Gervais & Odean, 2001; Konana & Balasubramanian, 2005)
	Illusion of knowledge	4	(Barber & Odean, 2001b, 2002; Konana & Balasubramanian, 2005)
	Illusion of control	4	(Barber & Odean, 2001b, 2002; Konana & Balasubramanian, 2005)
Social media	Post volume	5	(Antweiler & Frank, 2004; Chen et al., 2014; Phillips & Gorse, 2017; Tumarkin & Whitelaw, 2001; Wysocki, 1998)
	Sentiment	4	(Bollen, Mao, & Zeng, 2011; Karabulut, 2013; Siganos, Vagenas-Nanos,

			& Verwijmeren, 2014; Zhang, Li, Shen, & Teglio, 2016)
	Imitation	6	(Barber & Odean, 2007; Berger, Wenzel, & Wohlgemuth, 2018; Bouri, Gupta, & Roubaud, 2019; Doering et al., 2015; Hong et al., 2005; Shanmugham & Ramya, 2012)

3.4. Review of online investor overconfidence and social media usage

As illustrated by the concept-centric matrix, the following sections discuss literature exploring overconfidence among online investors. The first section identifies early literature which suggests that online investor overconfidence is caused by the self-attribution bias, the illusion of knowledge and the illusion of control. The second section describes online investors' usage of social media to gather others' investment opinions and decisions. Research questions regarding the overall impact of social media usage on online investor overconfidence are then formed.

3.4.1. Online investor overconfidence

Barber and Odean (2002) describe how overconfidence is often observed with online investors who invest excessively and speculatively, reducing overall returns. Their study describes three common characteristics of online investor behaviour that cause this overconfidence. They are the self-attribution bias, the illusion of knowledge and the illusion of control (Barber & Odean, 2000, 2001a, 2001b, 2002; Choi, Laibson, & Metrick, 2002; Konana & Balasubramanian, 2005). In Chapter 2, these characteristics are identified as drivers of enjoyment due to overconfidence among investors who engage specifically in copy trading. This chapter re-examines these characteristics in the broader perspective of general social media usage and their potential impact on overconfidence among online investors.

Langer and Roth (1975) describe how individuals consistently tend to attribute desirable outcomes to themselves and attribute undesirable outcomes to external

factors. This finding is applied by Barber and Odean (2002) to the context of online investing and is referred to as the self- attribution bias. The self-attribution bias is evident when investors attribute decisions with positive investment returns to themselves and negative investment returns elsewhere. It is suggested that the easily accessible information available to online investors facilitates the self-attribution bias (Gervais & Odean, 2001; Konana & Balasubramanian, 2005). In the context of this research, social media can provide this easily accessible information. Online investors can attribute unsuccessful investment outcomes to the information they gathered online and attribute successful investment outcomes to themselves by identifying the information they gathered as correct.

Barber and Odean (2002) describe how individuals' confidence levels increase when more information becomes available to them, this is referred to as the illusion of knowledge. Their study applies this concept to the context of online investing. By investing online, investors are exposed to vast amounts of information with which they base their investment decisions. Growth in online social networks and corresponding growth in user-generated content has changed how information is consumed online and has resulted in a larger volume of easily accessible information (Leskovec, 2011). Again, social media has been one of the reasons behind this large growth in information. The illusion of knowledge is evident when online investors believe that their returns will increase due to the volume of information available to them. By gathering a larger volume of information, investors often assume that the information is relevant and more likely to result in increased returns. This causes investors to believe they are more knowledgeable than they really are (Konana & Balasubramanian, 2005).

The third reason for overconfidence among online investors according to the research of Barber and Odean (2002) is the illusion of control. The illusion of control is based on the concept that an individual's control or involvement in a situation influences the outcome (Langer & Roth, 1975). Barber and Odean (2002) apply this to the context of online investing by describing how the internet allows investors to bypass traditional intermediaries such as brokers and place trades themselves. Today's disintermediated investment platforms such as eToro, allow online investors to be actively involved and in control of the investment process. Social media allows online investors to gather a variety of investment-related information themselves, further

facilitating active involvement and control over their investment decisions. This results in an illusion of control, increasing the investor's expectation of successful investment outcomes.

While previous literature has validated the self-attribution bias, illusion of knowledge and illusion of control as primary reasons for online investor overconfidence. It is plausible that by using social media to gather information, this overconfidence is increased. This consideration is formed on the basis that online investors use social media to gather a wide variety of information, primarily others' investment-related opinions and decisions.

3.4.2. Online investor social media usage

Literature investigating the opinions of investors using social media explores investor sentiment and its impact. Investor sentiment is defined as investor beliefs about "the true fundamental value of an underlying asset" (Zhang, 2008, p. 9). It is therefore assumed that investor sentiment represents the collective opinions of online investors regarding a certain financial instrument. Siganos et al. (2014) measure investor sentiment by analysing Facebook activity. Their study identified that certain user sentiment was reflected by market returns. For example, a decrease in a certain stock's price corresponded with the negative opinions of Facebook users regarding that stock. This validates the argument that market movements correspond to user sentiment on Facebook and that investors are influenced by others' opinions on social media. This corroborates the finding of Karabulut (2013) who identifies sentiment among US-based Facebook users as a valid predictor of temporary market movements. Other research investigates changes in user sentiment on Twitter and the corresponding changes in the Dow Jones Industrial Average (DJIA) index (Bollen et al., 2011). Their study finds that the DJIA can be predicted to a sufficient degree of accuracy when happiness and calmness are evident among Twitter users. These results are further validated by Zhang et al. (2016) who find a significant relationship between the sentiment of Twitter users in international markets and stock market performance. Considering investor sentiment represents the collective opinions of investors on a certain topic, these findings from existing literature illustrate how individuals collectively react to investment-related opinions of others on social media.

Typically, investment decisions involve choosing between financial instruments. Financial instruments are described as “contracts that give rise to a financial asset of one entity and a financial liability or equity instrument of another entity” (Staszkiewicz & Staszkiewicz, 2014, p. 5). Essentially, financial instruments are a contractual representation of the trading of financial assets such as a company’s shares. While investment decisions generally involve the consideration of alternative financial instruments, existing research, as discussed in Chapter 2, describes how social media allows online investors to directly imitate other investors’ decisions. This allows investors to primarily consider who to imitate instead of which financial instrument to invest in when making an investment decision. By imitating others, investors can reduce excessive financial analysis (Oehler, Horn, & Wendt, 2016). Growth in social media has fundamentally impacted how information is generated and consumed online (Leskovec, 2011). Investors can easily share their investment decisions online with full transparency (Glaser & Risius, 2018). In Bouri et al. (2019)’s study, investors in the cryptocurrency market are described as easily persuaded due to their reliance on social media and online chat forums for research. This finding suggests that online cryptocurrency investors use social media and online chat forums to imitate others in certain online communities. Imitation among online investors is particularly evident in social trading networks such as eToro, in which participants can directly imitate others via copy trading and inform their investment decisions based on information gathered in online communities (Doering et al., 2015). Copy trading, as discussed in Chapter 2, allows investors to “automatically, simultaneously, and unconditionally replicate other investors' trades” (Wohlgemuth et al., 2016, p. 1). With copy trading, the investment decisions of an individual are fully transparent and made available for other investors to copy automatically. The direct imitation of others’ investment decisions has been identified as particularly useful and popular among inexperienced investors (Berger et al., 2018; Pan, Altshuler, & Pentland, 2012).

Existing research exploring the usage of social media by investors clarifies that others’ investment opinions are widely available on social media with which online investors can use to inform decisions. It is also made clear that online investors use social media to imitate others’ investment decisions, most notably demonstrated on social trading platforms such as eToro. Taking this into consideration, the question arises as to how social media impacts online investor overconfidence due to the large volume of

varying information with which they can inform their investment decisions. Based on existing literature, overconfidence is enhanced as a direct result of an increase in the self-attribution bias, the illusion of knowledge and the illusion of control. It is proposed herein that the self-attribution bias is increased by social media as investors can attribute unsuccessful investment outcomes to the opinions and decisions of others and attribute successful investment outcomes the correct opinions and decisions of others' they gathered themselves using social media. Larger volumes of information made available to investors via social media, primarily in the form of others' opinions and decisions, suggests that the illusion of knowledge can be increased. Finally, disintermediated investment platforms could result in the illusion of control among online investors as per existing literature. From these suggestions, the overall research question is derived: does the use of social media impact online investor overconfidence? Semi-structured, qualitative interviews with investors who both use and don't use social media to gather investment-related information are conducted to explore this question.

3.5. Data collection method – Semi-structured, qualitative interviews

Interviews were conducted individually and in person with a total of fourteen participants over three weeks in August 2019. Similarly to Chapter 2, this study interviews key informants on the basis that they are knowledgeable in the fields appropriate to this study and offer more in-depth information than survey respondents representing a certain sample (Kumar, Stern & Anderson, 1993). This study explores the impact of social media usage on online investor overconfidence; therefore, key informants require knowledge in online investing. All key informants interviewed during this study are defined, as per Campbell (1955), as individuals who have directly invested their own money online and are willing to share how they gather information which informs their online investment decisions. While the study examines overconfidence among online investors who use social media to gather investment-related information, key informants who do not use social media to inform their investment decisions are also interviewed. This allows for a comparison of overconfidence among online investors who use social media to gather investment information and those who do not use social media.

In Myers's and Newman's (2007) examination of qualitative interviews as a data-gathering method in the information systems field, semi-structured interviews are

highlighted as being partially scripted but allow for adaptability based on a participant's answers. This flexibility allows the interviewer to critically analyse certain situations. Schultze and Avital (2011) discuss how qualitative interviews allow participants to "articulate and interpret their experiences" (p. 5). In the context of this study, the qualitative interviews conducted are semi-structured allowing the interviewer to adapt appropriately to the answers received. This is used to generate detailed descriptions of online investor overconfidence and social media usage. These descriptions were gathered with the research question in mind; how is online investor overconfidence impacted by social media usage? By gathering detailed, qualitative data from both online investors who use social media and online investors who don't use social media to inform their investment decisions, overconfidence as a result of social media usage can be analysed by comparison. The interview questions are shown in Table 3-2.

Table 3-2: Interview questions.

Questions asked during interviews:	
1.	What financial instruments have you invested in online?
2.	If your investment is successful, what do you attribute the success to?
3.	If your investment is unsuccessful, what do you consider to be the cause?
4.	In your opinion, how well informed are you before making an investment?
5.	When making an investment, how confident are you that it will be successful?
6.	Do you consider others' opinions before making an investment?
7.	Do you look online to gather others' opinions before making an investment?
8.	Do you use social media to gather others' opinions before making an investment?
9.	Do you imitate the investment decisions of others
10.	Would you imitate the decisions of an investor on social media with interests and expertise in areas similar to you?

Table 3-3: Interview summary

Chapter 3: Semi-structured, qualitative interviews	
Date Span:	5/8/19 – 23/8/19
Interview Type:	Individual
Number of Participants:	14

Average Interview Time:	28 minutes
Tools Used for Analysis:	Google Forms, Google Sheets
Transcription Method:	Typed during the interviews by the interviewer.
Coding Method:	Participants' answers were initially analysed by category, then coded and finally interpreted in relation to the underlying research question (Flick, 2008)
Choice of Interviewee:	Key informants were interviewed on the basis that they were knowledgeable in the fields appropriate to the study and offered more in-depth information than survey respondents representing a certain sample (Kumar, Stern & Anderson, 1993). Key informants were considered knowledgeable and experienced in online investing and were willing to share how they gather investment-related information online. Online investors who had not used social media to inform their investment decisions were also interviewed for comparative purposes.
Questions:	
1. What financial instruments have you invested in online? 2. If your investment is successful, what do you attribute the success to? 3. If your investment is unsuccessful, what do you consider to be the cause? 4. In your opinion, how well informed are you before making an investment? 5. When making an investment, how confident are you that it will be successful? 6. Do you consider others' opinions before making an investment? 7. Do you look online to gather others' opinions before making an investment? 8. Do you use social media to gather others' opinions before making an investment? 9. Do you imitate the investment decisions of others? 10. Would you imitate the decisions of an investor on social media with interests and expertise in areas similar to you?	

3.6. Interview results

Interview results were typed by the interviewer while the interviews took place. A Google Form was created with each of the ten questions listed in Table 3-2. The answers provided by participants were typed into the corresponding question in the Google Form. By recording responses in this form, the data from the interviews was automatically stored in a Google Sheets spreadsheet. This allowed for the qualitative data gathered to be easily compared and analysed.

Participants' answers were initially analysed by category, then coded and finally interpreted in relation to the underlying research question (Flick, 2008). While

analysing data by category, participants' answers were categorised based-on Barber and Odean (2002)'s characteristics of online investor overconfidence examined during this study; the self-attribution bias and the illusion of knowledge. For the self-attribution bias category, the answers to questions two and three were included. For the illusion of knowledge, the answers to questions four and five were included. From there, participants' answers to questions six, seven, eight, nine and ten were categorised based on whether or not they use social media to inform their investment decisions and why. These categories were then coded by cross-referencing the participants' answers during analysis. For instance, a particular participant's answers to questions two and three might reveal the self-attribution bias, their answers to questions four and five might reveal the illusion of knowledge and their answers to questions six, seven, eight, nine might also reveal that they use social media to gather-investment related information. The data would be further examined to gain insights into why this participant who uses social media to gather investment-related information demonstrated the self-attribution bias and illusion of knowledge.

Once all interviews had been analysed and coded, these insights could be interpreted to identify patterns and recurrences in the data gathered. From there, the underlying research question was considered; how is online investor overconfidence impacted by social media usage? By firstly categorising participants' answers based on the self-attribution bias, the illusion of knowledge and finally, social media usage, then coding by cross-referencing answers from these categories, the impact of social media usage on online investor overconfidence could be examined.

Of the participants who use social media to inform their investment decisions, a recurring theme was evident regarding the self-attribution bias. This study suggests that the self-attribution bias is evident among participants who use social media as they can attribute unsuccessful investment outcomes to the opinions and decisions of others and successful investment outcomes to the correct information they gathered themselves. When asked what they attribute to unsuccessful investment outcomes, the majority of participants didn't mention their own actions. Instead, they attributed the outcomes to the information they received online or others' opinions. Answers such as "I took a chance following what I saw online" and "the lack of inappropriate information online" illustrates how participants associated their unsuccessful investment outcomes with the information they received online. Other answers such

as “following the crowd/popular trends” illustrate that participants’ also associated unsuccessful investment outcomes with the opinions and decisions of others online. Additionally, participants who invested in cryptocurrencies suggested that the volatility of cryptocurrencies was the primary reason for their unsuccessful investment outcome. These answers don’t specifically attribute others’ opinions and decisions on social media to participants’ unsuccessful investment outcomes. However, they sufficiently illustrate the tendency of participants who inform their investment decisions using social media to associate unsuccessful investment outcomes with factors other than their own actions. When asked what they attribute to successful investment outcomes, the majority of participants mentioned their own actions in gathering information online or their own investment decision-making. This is consistent with the self-attribution bias. Answers such as “research” and “adequate reading” illustrates how participants attributed successful investment outcomes to the information they gathered themselves online. Other answers such as “informed decisions” and “not making emotional decisions” further suggest that participants who use social media to inform their investment decisions are inclined to attribute successful investment outcomes to their own decision-making. This, combined with a tendency to associate unsuccessful investment outcomes with factors other than their own actions, illustrates the self-attribution bias among participants who use social media.

Following this, a similar recurring theme was observed regarding the illusion of knowledge among participants who use social media to inform their investment decisions. The illusion of knowledge suggests that online investors believe their returns will increase due to the volume of information available to them. This study suggests that social media enhances the illusion of knowledge on the basis that it provides large volumes of easily accessible investment-related information. When asked how informed they feel prior to making an investment decision, participants who stated that they use social media said they felt “informed”, “well informed” or “very informed”. No participant gave any indication that they didn’t feel informed prior to making an investment decision. This was further reflected by answers from the same participants when asked how confident they feel prior to making an investment decision. The majority of participants stated that they felt “confident” or “very confident”. However, the participants who stated that they were “not confident”

were in the minority and had previously stated stating that they felt “well informed” prior to making an investment. In addition to this, the same participants had also demonstrated the self-attribution bias, offsetting this perceived lack of confidence. A feeling of being confident, combined with a feeling of being well informed prior to making an investment decision, suggests that the illusion of knowledge is evident among participants who gather investment-related information using social media.

In comparison, the self-attribution bias was examined among participants who do not use social media to gather investment-related information. This comparison is made to clarify the extent to which using social media impacts the self-attribution bias among participants. When asked what they attribute to unsuccessful investment outcomes, participants provided answers such as “poor judgement”, “a lack of experience”, “not thinking decisions through properly”, “getting my timing wrong” and “ineffective strategy execution”. These answers illustrate how participants associate their unsuccessful investment outcomes with their own investing ability, actions and decisions. By doing so, these answers are in contrast to participants who use social media to inform their investment decisions. When asked what they attribute to successful investment outcomes, participants who don’t use social media mentioned the advice they received from others; this is inconsistent with the self-attribution bias. This was most notable when participants provided answers such as “good advice” and “good information from peers”. Similar to participants who use social media, certain participants attributed successful investment outcomes to their own research. This answer was, however, in the minority and the same participants associated unsuccessful investment decisions with their own “poor judgement” and “bad research”. These results reveal that the self-attribution bias is not evident, or as evident, among online investors who do not use social media to gather investment-related information. This is the opposite of participants who do use social media. The reason self-attribution bias is not evident in those who do not use social media for investment advice is that they are inclined to attribute unsuccessful investment outcomes to their own actions and decisions and attribute successful investment outcomes to peer advice.

The illusion of knowledge was then examined among participants who do not use social media to gather investment-related information. Again, results were compared with those who use social media to clarify the extent to which the availability of this

information on social media impacts the illusion of knowledge. The results revealed similarities to investors who use social media. When asked how informed they feel prior to making an investment decision, participants said they felt "informed", "well informed" or "very informed". No participant gave any indication that they didn't feel informed prior to making an investment decision. When asked how confident they feel prior to making an investment decision, participants said they felt either "confident" or "very confident". Similarly, no participant gave any indication that they didn't feel confident prior to making an investment decision. Overall, participants stated that they generally feel confident and well informed. This finding reveals that the illusion of knowledge is evident again, however, this time it is also evident among participants who do not use social media to gather investment-related information.

Table 3-4: Summary of results

	Investors who use social media to gather investment-related information	**Investors who do not use social media to gather investment-related information**
Self-attribution bias	✓	X
Illusion of knowledge	✓	✓
Illusion of control	✓	✓

Table 3-4 summarises the findings of interviews conducted with participants who use and don't use social media to gather investment-related information. Participants who use social media demonstrate the self-attribution bias and the illusion of knowledge. Participants who don't use social media demonstrate the illusion of knowledge, however, do not demonstrate the self-attribution bias. The illusion of control occurs when an online investor's active involvement in the investment process creates a perceived sense of control over the investment outcome. All participants interviewed during this study directly invest online using disintermediated, investing platforms. Therefore, all participants are actively involved in the investment process and the illusion of control can be assumed. Barber and Odean (2002) describe how online investors become overconfident as a result of the self-attribution bias, the illusion of

knowledge and the illusion of control combined. Consistent with this finding, Table 3-4 illustrates that each of these characteristics of overconfidence is evident among online investors who use social media. In contrast to the findings of Barber and Odean (2002), participants who do not use social media are found to demonstrate only two of the three characteristics. The illusion of knowledge and the illusion of control were found to be present; the self-attribution bias was not. Overall, these findings align with the findings of Barber and Odean (2002), who identified three characteristics that when combined, cause overconfidence. These are the self-attribution bias, the illusion of knowledge, and the illusion of control. The results of this study as illustrated by Table 3-4, suggest that investors who use social media to gather investment-related information demonstrate these three characteristics and are, therefore, overconfident. In comparison, investors who do not use social media to gather investment-related information demonstrate the illusion of knowledge and the illusion of control, however, do not demonstrate the self-attribution bias. This implies that they are not overconfident as per Barber's and Odean's (2002) characteristics.

An additional finding was noted following the interviews. All participants who use social media to inform their investments have invested in cryptocurrencies online. In comparison to this, the majority of participants who do not use social media have never invested in cryptocurrencies. This suggests that online cryptocurrency investors are more likely to rely on social media to make investment decisions than online stock market investors and, as a result, are more likely be overconfident in their investment decisions than online stock market investors.

3.7. Conclusion

This study's findings reveal that overconfidence is evident among online investors who use social media to gather investment-related information. Overconfidence is confirmed based on the combination of the self-attribution bias, the illusion of knowledge and assumed illusion of control (Barber & Odean, 2002; Gervais & Odean, 2001; Konana & Balasubramanian, 2005). In contrast to this, results further reveal that online investors who do not use social media to gather investment-related information demonstrate the illusion of knowledge but not the self-attribution bias. The illusion of control is again assumed. This suggests that online investors who do not use social media are not overconfident as per Barber and Odean (2002). It is plausible that this finding is due to factors such as an investor's competency and experience level. This

presents an avenue for further research to test this finding. An additional finding highlights that online cryptocurrency investors rely more heavily on social media to gather investment information than online stock market investors. As a result, online cryptocurrency investors are more likely to be overconfident.

These findings have implications for practitioners. This study suggests that online investors become overconfident when they use social media to gather others' opinions and imitate others' decisions. This highlights that social media should be approached with caution by online investors when intended to be used to inform an investment decision. This study also provides further evidence that a section of online investors uses social media to gather others' opinions and imitate others' decisions. This suggests that investment managers can use social trading platforms as a channel to reach retail investors.

Finally, this chapter sheds light on avenues for future research. The self-attribution bias, illusion of knowledge and illusion of control are further validated as reasons for overconfidence. In this study, it was found specifically among online investors who rely on social media for investment information. However, the self-attribution bias is not evident among online investors who do not use social media to gather investment information. Future research could further explore and refine the differences between investors who use social media to gather investment-related information and investors who don't. While the self-attribution bias, illusion of knowledge and illusion of control are examined as characteristics of overconfidence among online cryptocurrency and stock market investors, investors in other asset classes were not interviewed. Research including investors in other asset classes could further refine these findings and their implications.

Chapter 4. Investor decision making: The impact of modality on information completeness.

4.1. Abstract

This study hypothesizes that the modality effect can enhance an investor's ability to learn from investment-related information and ultimately better inform their investment decision. To test this, two separate systems were designed using a Repertory Grid analysis conducted with key informants to elicit features and functionalities. Each system provided the same information about a fictional stock to two separate groups of retail investors. One system provided solely visual information and the other provided a combination of audible and visual information. Each groups' ability to retain and transfer information was then examined. This was done by testing for the modality effect which states that learning is enhanced when processing concurrent audible and visual information. The results showed a reverse modality effect, suggesting there is no benefit to investors by replacing text with audio when accompanying related visual information. However, investors using the system with combined audible and visual information took a shorter amount of time on average, to process this information than the investors using the solely visual system. These findings suggest that combined audible and visual information does not enhance an investor's ability to learn from investment-related information and ultimately, that investor decisions are better informed by solely visual information. It is also noted that that combined audible and visual information results in a quicker response time among participants. However, this quick response time causes participants to process information with less accuracy, leading to erroneous decisions.

4.2. Introduction

In Gibson's (1992) study of financial information for decision making, a model is derived in which individuals consider the "utility of outcomes" before making the decision (p. 2). This model is built on the core assumption that complete information is available to the decision-maker. Therefore, in the absence of complete and perfect information, the decision made may not result in the optimum outcome. The question remains as to how to ensure that the required information is available to those making financial decisions.

Information modality refers to the use of different "sensory channel used to process information" (Moreno, 2006, p. 1); an example of this is the processing of audible or visual information. Instances of audible information are voice assistants such as Apple's Siri, Microsoft's Cortana and Amazon's Alexa (Hoy, 2018) utilising advancements in natural language processing (Hirschberg & Manning, 2015) and Voice-based User Interfaces (Ghosh, Foong, Zhang, & Zhao, 2018). While advances in this technology are evident, existing literature that compares voice and text in questioning answering (QA) systems has shown mixed results. While research has been conducted comparing singular modes of information communication, Sharma, Pavlović and Huang (2002) suggest that multimodal human-computer interaction can improve the flow of information between the user and computer systems. In the context of this study, multimodal human-computer interaction refers to human-computer interaction both audibly and visually.

Amazon's Echo Show uses two separate modes of information communication: visual when information is displayed on the Echo Show screen and audible when interacting verbally with Alexa - Amazon's voice-based personal assistant. Previous research has identified the modality effect, which describes how learning is enhanced when text is replaced by audible information accompanying a related piece of visual information (Ginns, 2005). To date, the modality effect has not been considered in the area of investors making investment decisions. This study hypothesizes that the modality effect can enhance an investor's ability to learn from investment-related information and ultimately better inform their investment decision. This will be tested by using the Amazon Echo Show which can display investment-related information both visually onscreen and audibly using Alexa. By using the Amazon Echo Show, the study applies the findings of previous modality effect literature to the specific context of retail investor decision making. During this study, retail investors are defined as "individuals who own stock by any means" (O'Hare, 2007, p. 3).

The study begins by describing information modality through an examination of existing literature. The following section identifies features of electronic systems that are used in previous literature to test for the modality effect. From there a Repertory Grid analysis is performed with key informants to derive features and functionality for this study's Amazon Echo Show system. Following this, the testing procedure is described in which the Amazon Echo Show is used with another group of key

informants to test investor decision-making through the lens of the modality effect. The next section outlines the results and analysis of the tests performed. Following this, the implications of these results from testing are discussed. Finally, the study concludes with practical implications and avenues for future research.

4.3. Information modality

Baddeley (1992) developed a working memory model consisting of several interrelated subsystems. Two of these subsystems process visual and audible information separately: these are the "visuo-spatial scratch pad" and "articulatory loop respectively" (p. 1). The visuo-spatial scratch pad processes visual information and has recently also been referred to as the visual-spatial sketchpad (Leahy & Sweller, 2011, p. 2). The articulatory loop is divided into two subcomponents: the phonological input store and the articulatory rehearsal process which both process audible information.

Van Merrienboer and Ayres (2005) describe "extraneous cognitive load" as excessive amounts of information being processed by certain components of working memory such as the articulatory loop or visual-spatial sketchpad (p. 1). An example of this is the work of Leahy and Sweller (2011), where a group of subjects process visual-only information, in the form of a diagram and on-screen text, less effectively than when the same diagram is displayed with the text replaced by audible information. This demonstrates that when working memory is split between visual and auditory processors, the ability to deal with information may be increased by using both processors concurrently rather than just one.

This demonstration of increased capacity in working memory is referred to as the modality effect. The modality effect is evident when audible information displayed concurrently with related visual information enhances learning more effectively than visual information on its own. The audio/visual information presented must be directly related; if the information only complements other information in a different modality, the modality effect will not be obtained (Low & Sweller, 2005). The modality effect is also referred to as the "separate stream hypothesis" (Penney, 1989, p. 1) or "split attention effect" (Mousavi, Low, & Sweller, 1995, p. 1). A reverse modality effect is obtained when visual information on its own enhances learning more effectively than audible information displayed concurrently with related, visual information (Inan et

al., 2015; Leahy & Sweller, 2011). To test for the modality effect among retail investors, we examine existing literature to determine which system features are likely or unlikely to result in a modality effect with financial decision making.

4.4. System features in modality effect literature

To determine which features are required in an audio/visual system to optimise financial decision making, a systematic review (Webster & Watson, 2002), as used in chapters 2 and 3 in this thesis, was carried out of existing literature on the modality effect. Article databases such as the AIS Electronic Library, Google Scholar, ScienceDirect, SSRN, and Web of Science were explored for relevant literature using the following keywords 'financial decision making', 'online investing', 'voice-based user interface', 'natural language processing', 'information modality' and 'modality effect'. Leading research journals were then examined. The journals examined included Learning and Instruction, British Journal of Educational Technology, Journal of Computer Assisted Learning, Journal of Experimental Psychology, and Educational Technology Research and Development. Citations of identified articles were used as further research sources.

During the systematic literature review, recurring core features of audio/visual systems are identified that can result in a modality effect with participants. This study considers that investor decisions will be enhanced as a result of the modality effect. In order to examine this, the core features that result in a modality effect are incorporated in the design of a system to test for the modality effect among investors. These features are described in detail below (with the core concepts identified by italics).

In the literature, there is an emphasis on the importance of information length when testing for the modality effect. While displaying an instructional diagram in experiments, Mayer and Moreno (1998) obtained a modality effect when related audible narration accompanied the diagram. Results of this study revealed that concise and highly concentrated audible narration of visual diagrams allowed participants to process the information most effectively when in parallel in working memory. This study, and others such as Inan et al. (2015), prove that for the modality effect to be present, audible information must be short and concise.

Leahy and Sweller (2011) observed that long and complex information transmitted audibly and visually resulted in a reverse modality effect. Their study revealed that

detailed, longer pieces of information may excessively load working memory when presented in audible form rather than written form. Inan et al. (2015) reiterate this by observing that learning improved when long, spoken text was replaced by written text when presenting unfamiliar information to participants. This suggests that long and detailed information should be communicated in a solely visual way; however, the modality effect was evident with shorter pieces of information when transmitted both audibly and visually.

The timing of audible information impacts the performance of participants according to previous literature (Mayer & Anderson, 1992). For example, Mayer's (1997) study identifies that subjects perform better when visual information is processed with concurrent rather than sequential narration. Moreno and Mayer (1999) tested the modality effect by providing participants in their study with a visual describing the formation of lightning narrated with audible information both before and after the visual in different tests. Findings revealed the modality effect was present as participants' connections between corresponding visual and verbal information more effectively. This suggests audible information displayed concurrently with visual information assists with the modality effect. In another study, Moreno and Mayer (1999) provided audible narration and text either concurrently or sequentially in different tests with participants. Findings revealed an advantage of audible narration over text; however, this advantage did not disappear when presentations were made sequential contrasting previous findings suggesting the superiority of concurrent audible information.

Moreno's and Mayer's (1999) study tests the idea that the modality effect is achieved more effectively when visual information is close in proximity (Mayer & Anderson, 1992). This was done by presenting concurrent visual text and related animations to participants. The text was displayed at the bottom of the screen for one test and next to the corresponding part of the diagram for the other. Results showed that the interpretation of information is impaired when on-screen text is spatially separated from the visual materials. This is consistent with results from Inan et al. (2015)'s study that suggests information that isn't displayed in close proximity can plausibly result in a reverse modality effect. In summary, to effectively display and communicate information in an audio/visual way, the information should be condensed into a smaller visual field.

Rummer, Schweppe, Fürstenberg, Seufert, and Brünken (2010) investigate the modality effect by testing each subject's ability to recall sentences and unrelated visual diagrams (matrices), one simple, one more complex. The study examines the impact of eye-movement on the participants' ability to recall sentences by displaying the sentence for one group word-by-word in the centre of the screen, followed by the matrices. Results suggest participants listening to sentences or reading with less eye-movement outperformed those in the standard reading group regarding matrix recognition. This demonstrated that eye-movements during reading hamper participant's ability to process information and reiterate the previous findings that visual information should be condensed (Moreno & Mayer, 1999).

Tabbers, Martens, and Van Merrienboer (2001) investigate the modality effect with an interactive system where either the user or the system controls the pace of the information displayed depending on the experiment. In one experiment, participants used a system with a predetermined pace for displaying information, results suggested the superiority of audio over visual text as narration, essentially yielding a modality effect. In a second experiment, where users had control over the pacing of the instructions, retention of information by participants with visual information outperformed those with audible information, yielding no modality effect. This result is replicated more recently by Tabbers, Martens, and Van Merriënboer (2004) and Inan et al. (2015), suggesting that when participants have more time or control the pace of the information displayed, a reverse modality effect can be demonstrated.

Tabbers et al. (2004) investigate the impact of visual cues on the modality effect; in this case, visual cues refer to certain pieces of visual information. They are utilised to reduce visual search in multimedia presentations, thus increasing effectiveness. The testing involved a non-technical diagram accompanied by either visual text or audible instructions. To reduce visual search, visual cues in the form of bright red colours referring to specific parts of the diagram were applied. Results highlighted that visual cues were only effective in terms of retaining the information portrayed by the diagram, however no difference in terms of mental effort spent or ability to transfer information was noticed, yielding an overall reverse modality effect.

In summary, the system features and functionalities identified during this review have been tested in previous literature on the modality effect. This analysis of existing

research has determined which features are essential to building an effective audio/visual system. While existing research has shed light on which features are essential to building an effective audio/visual system, the contexts vary. This study investigates the modality effect specifically in the context of retail investing, therefore, system features identified as relevant to the modality effect will be presented to a group of retail investors during interviews. The results of these interviews with key informants will inform the functionality of an audio/visual system that presents investment information to retail investors. Table 4-1 illustrates which system features yield either a modality effect or a reverse modality effect according to the literature described above. These system features are used as elements in a RepGrid analysis (Bernard & Flitman, 2002) with investors, from which system functionality is derived during interviews. This is described in detail in the next section below.

Table 4-1: Potential system features found in previous literature and corresponding modality effect outcomes.

System Features	Modality Effect	Reverse Modality Effect
Short, concise information	✓	
Long, detailed information		✓
Concurrent audio/visual information	✓	
Sequential audio/visual information	✓	
Visually condensed information	✓	
System-paced information	✓	
User-paced information		✓
Visual cues		✓

4.5. RepGrid analysis

To test for the impact of audio/visual information on retail investor decision making, a visual and audio/visual system was required for comparative testing. These systems were built using an Amazon Echo Show which displayed information about a fictional stock onscreen for visual-only testing. For audio/visual testing, audible information

was presented using Amazon's voice assistant Alexa, and visual information was presented onscreen. The RepGrid analysis was used as an interviewing technique with the targeted user group, retail investors, to elicit how information should best be presented by the system.

Kelly (1977) derived the RepGrid analysis from his personal construct theory which improves the interpretability of an interview participant's views and opinions. Further literature describes how RepGrid interviews reduce bias and allow for participants to interpret certain topics in a less restricted way (Hunter, 1997). In the context of information systems, the RepGrid analysis has been validated as a useful method for the cognitive analysis of users (Tan & Hunter, 2002). The RepGrid analysis has also been described as a useful qualitative interviewing technique to gather unbiased information systems data (Hunter, 1997).

There are four components to the RepGrid analysis: the topic, the elements, the constructs, and ratings (Easterby-Smith, 1980). The topic of this analysis is the impact of audio/visual information on investor decision making. Elements are considered to be instances of the topic: in this case, ways of communicating audio/visual information to investors. The elements were derived from the systematic literature review and are outlined in Figure 4-1. Constructs are considered to be opposing opinions of elements (Coshall, 2000; Kelly, 1977). Constructs are derived during the construct elicitation stage of the interview in which a triadic comparison is used (Kelly, 1955; Kelly, 1970). A triadic comparison occurs when the interviewer presents the participant with three elements from the RepGrid and asks the participant to identify a way in which two of the elements are similar yet different from the third. Bernard and Flitman (2002) state the way in which two of the three elements are similar in a positive way forms the likeness pole and the way in which the third element differs negatively forms the contrast pole. In order to understand the context and meaning of a particular construct, Hinkle (1965) conceived laddering as a technique to further explore relationships between constructs by identifying and developing a hierarchy. In this study, laddering up was used to reveal superior constructs within the hierarchy (Stewart, Stewart & Fonda, 1981). In interviews, participants are asked which pole they prefer and why to ladder up (Bernard & Flitman, 2002). Ratings are then used to link constructs and elements (Hunter, 1997). A Likert scale with five intervals is used to allow participants rate the elements based on the constructs, with one being the likeness pole on the left

and five being the contrast pole on the right (Fransella, Bell, & Bannister, 2004). Typically the lower numbers relate to the more positive pole (Harter, Erbes, & Hart, 2004).

4.5.1. RepGrid interviewing procedure

The RepGrid analysis interviews were conducted over three weeks in March 2019. These interviews were conducted with a group of four key informants (McAvoy, 2006). Each participant was selected from a group of investors running and managing a retail investment fund. Key informants aren't intended to represent a certain population statistically (George & Reve, 1982). Instead, they have a higher level of knowledge in the field being researched and are willing to communicate this knowledge (Campbell, 1955). Babbie (1998) describes how key informants are particularly effective when research targets theoretical concepts that aren't well understood. This study considers that retail investors can enhance their ability to learn from investment-related information via the modality effect, resulting in better-informed decisions. While investor decision making has been thoroughly researched, the application of the modality effect to the context of investor decision making hasn't been researched previously, therefore, it isn't well understood. With this in mind, key informants are deemed appropriate to interview. As per Campbell's (1955) description, key informants are selected from a group of investors running and managing a retail investment fund and who are willing to share their experiences with systems they've used to receive investment information.

The interviews were conducted individually. Initially, the context of the research was explained to participants. The description of this context involved explaining how the research was focused on the presentation of information to retail investors during a comparative analysis of a fictional stock. It was then explained that the purpose of the interviews was to identify the format in which retail investors preferred to receive information.

The RepGrid was presented to participants populated with just the elements as shown in Figure 4-1. The elements were described to participants as being derived from existing literature and are ways of presenting audio/visual information. Participants completed a triadic comparison in which the interviewer presented three separate cards, each with one element from the RepGrid. The interviewer then asked: "c" The

corresponding answers were written by the interviewer in the RepGrid forming constructs. An example of this from interviewing was the triadic comparison of the elements: long and complex information, visually condensed information, and visual cues. Each element refers to how information is presented to the retail investor. One participant described how visually condensed information and visual cues are similar in that they are visual; and that long and complex information differs in that long, complex information is more often text-based and non-visual. Therefore, the construct <visual – non-visual> was formed as shown in Figure 4-1. The triadic comparison process was repeated with different combinations of elements until similar constructs started emerging. Laddering was then used as a technique to identify hierarchical relationships amongst the constructs. Participants were asked: "Which pole do you prefer and why?". Figure 4-1illustrates that the participant preferred "Visual" as it allows information to be more easily interpreted, this resulted in the superordinate construct <easily interpreted – hard to interpret>. Following laddering, the respondent was asked to rate all information regarding each construct, using the Likert scale discussed above with one referring to the likeness pole and five referring to the contrast pole.

	Elements								
Likeness Pole	Long & Complex Information	Short & Concise Information	Visually Condensed Information	Concurrent Display	Successive Display	User-paced Interaction	System-paced Interaction	Visual Cues	Contrast Pole
Easily Interpreted	3	2	2	1	3	1	4	1	Hard to interpret
Visual	4	1	1	2	2	3	3	1	Non-visual
Total	**7**	**3**	**3**	**3**	**5**	**4**	**7**	**2**	

Figure 4-1: Sample RepGrid from interviews

4.5.2. RepGrid interview results and elicitation of system features

To derive system features and functionality for the financial decision-making system, RepGrid interview results were analysed based on participant ratings of elements. For each element, ratings were summed and noted at the bottom of the column as can be seen in Figure *4-2*. Five triadic comparisons of elements resulted in five constructs describing elements positively in the likeness pole and negatively in the contrast pole according to participants. Laddering up followed the triadic comparisons to derive superordinate constructs, which explained why certain elements are positive in the likeness pole or negative in the contrast pole. While rating each element, one referred to the likeness pole and five referred to the contrast pole as described above, therefore

lower total ratings indicated a participant's preference for a certain element. The ratings were totalled for each element, total ratings from each interview were then added together to provide an overall rating for each element. The overall total was then used to quantify priority amongst elements with the lowest total being of the highest priority and the highest total being of the lowest priority as system features. Figure *4-2* shows the total for each element per interview, an overall total rating and a priority ranking.

	Long & Complex Information	Short & Concise Information	Visually Condensed Information	Concurrent Display	Sucessive Display	User - Paced Interaction	System-Paced Interaction	Visual Cues
Participant 1	40	29	21	27	31	30	32	25
Participant 2	26	27	31	28	31	28	26	25
Participant 3	21	24	20	19	22	18	29	21
Participant 4	28	33	25	35	32	30	33	34
Total Rating	115	113	97	109	116	106	120	105
Priority Ranking	**6**	**5**	**1**	**4**	**7**	**3**	**8**	**2**

Figure 4-2: RepGrid results including the total rating for each element per interview, an overall total rating and a priority ranking.

Based on the requirements identified and prioritised in the RepGrid interviews, two proof of concept (POC) systems were developed which displayed information about a fictional stock to a group of retail investors. Elicitation of system features was based on priority rankings of elements as shown in Figure *4-2*. System features were prioritised as follows; visually condensed information, visual cues, user-paced interaction, concurrent display, short and concise information, long and complex information, successive display and system-paced interaction. One POC was created that presented information onscreen in a solely visual way, the second POC was created to present information in an audio/visual way - visually onscreen and audibly through the Amazon Echo Show's voice assistant, Alexa. Both systems were tested with separate groups of key informants to investigate the modality effect and its impact on retail investor information.

4.6. Testing procedure

The participants chosen for testing were a different group of key informants from the group of investors who took part in the RepGrid analysis. Considering the purpose of the RepGrid analysis was to derive suitable system features for testing both visual and audio/visual systems, different key informants were chosen for testing to remove any potential bias. During testing, participants received information about a fictional stock

(STK). The stock was fictional to allow participants to focus solely on the information presented during testing. One group of participants viewed the information onscreen in a solely visual way (Visual Test Group), with no audible information available, and no ability to interact with Alexa once the information was displayed. Another group of participants viewed the information onscreen with audible interaction (Audio/Visual Test Group). Audible information was available upon request by speaking to Alexa. Participants were allocated to either the Visual Test Group or the Audio/Visual Test Group at random, each group consisted of seven participants.

4.6.1. Visual test group testing procedure

Figure 4-3 displays the information provided to participants in the Visual Test Group. The price change of this stock included visual cues to allow participants to interpret the price-performance more easily as suggested by the RepGrid analysis. Font colour was used as a visual cue with any negative change in price percentage represented by red font, and any positive change in price percentage represented by green font.

A chart displaying price movement of the stock over one day was located close in proximity to the price percentage changes to align with the results of the RepGrid analysis suggesting information should be condensed visually.

Revenue and market capitalisation information was displayed on the right-hand side of the chart. Bold text was used as a visual cue to emphasise the figures for revenue and market capitalisation. Information regarding peer performance and historical comparison of revenue and market capitalisation were displayed with short and concise pieces of information, condensed visually using bullet points and narrow margins. The inclusion of visual cues, visually condensed, and short and concise information was again, in line with findings of the RepGrid analysis.

News headlines were displayed in close proximity beneath the chart. These headlines were also short and concise with italic font used as a visual cue to allow participants to make a distinction between headlines and other information.

Participants began processing the information onscreen. Participants could finish processing the information whenever they felt ready to move onto the next section of testing. This aligns with results of the RepGrid analysis that suggest a priority should be placed on user-paced system interaction.



Figure 4-3: Information presented to Visual Test Group during testing.

4.6.2. Audio/visual test group testing procedure

Figure *4-4* displays the information provided to participants in the Audio/Visual Test Group. Similar to the previous visual group testing procedure, visual cues and visually condensed information were prioritised in order to apply the findings of the RepGrid analysis to the Audio/Visual testing procedure. Green and red font colours were used as a visual cue to inform the participant about positive and negative price changes respectively. Bold text was used as a visual cue to emphasise the figures for revenue and market capitalisation. For the condensed visual information, again, the stock's price chart was located close in proximity to the changes in price percentage.

While the audio/visual test group used similar features to the visual test group such as visual cues and visually condensed information, participants in the audio/visual test group interacted with the system using their voice, i.e. audibly. To view the information in Figure *4-4* and initiate testing participants stated: "Alexa, ask State Street app to show the stock." Alexa then audibly stated the information displayed onscreen. Additional information for peer performance, historical comparisons and news were available to participants with further questioning described below. Additional information delivered audibly was exactly the same as the information provided visually for the Visual Test Group.

For a participant to request revenue information they would state: "Alexa, tell me about the revenue". Alexa would then respond audibly: "This was the highest revenue of all technology companies in the S&P 500. S&P 500 technology companies average

revenue growth over the last 5 years is 1.8%. Revenue is down 1% on last year. Revenue is up 2% on average in the last 5 years."

For a participant to request market capitalisation information they would state: "Alexa, tell me about the market cap". Alexa would then respond audibly: "This is the third-largest technology company by market cap. The market cap is up 1% on last year. Market cap is up 5% on average over the last 5 years."

For a participant to request information from the news they would state; "Alexa, tell me about the news". Alexa would then respond audibly: "Report shows STK streaming service has lost subscribers in the last 6 months. STK earnings report indicates the growth and success of recent products. Ground-breaking STK payments product doubles its market share in the last year."

Participants began processing information both onscreen and audibly. Participants could finish processing this information whenever they felt ready to move onto the next section of testing. Again, this aligns with results of the RepGrid analysis that suggest a priority should be placed on user-paced system interaction and to ensure consistency with the test for the visual test group. All information provided audibly was short and concise, consistent with RepGrid findings. Participants could ask Alexa for additional, audible information as many times as they deemed necessary.

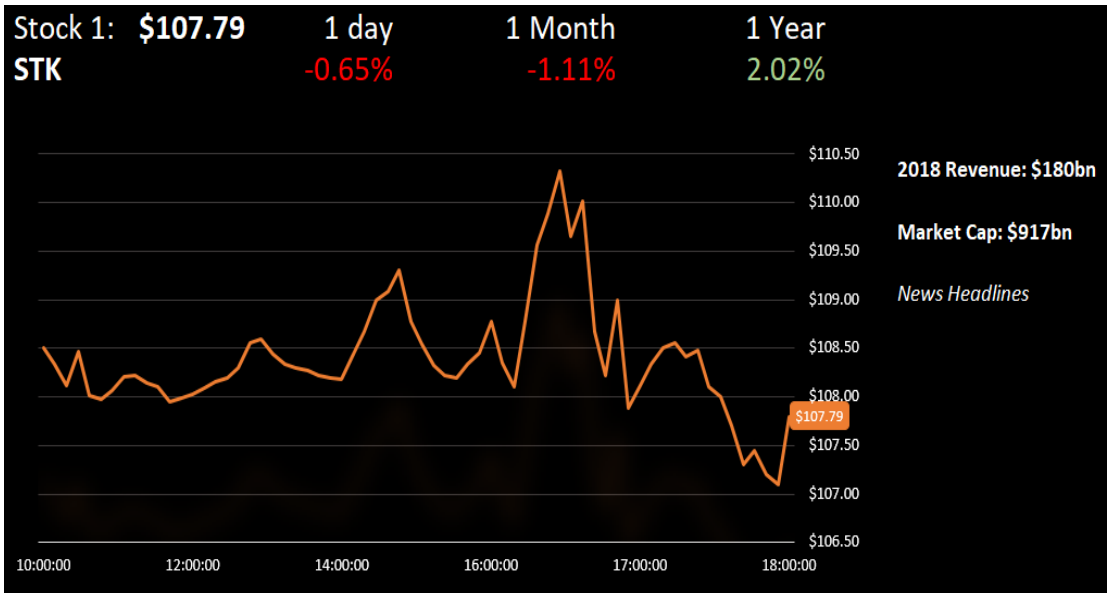


Figure 4-4: Information presented to the Audio/Visual Test Group during testing, additional audible information was available when requested from Alexa.

4.6.3. Retention test

To reveal a modality or reverse modality effect, each participant's ability to retain information from testing was assessed. Six questions were asked regarding the information presented during both visual and audio/visual tests, and the answers were scored for accuracy. Table 4-2 presents each question asked during the retention test, possible correct answers and the corresponding points awarded. For example, for question 1, "What is the stock price?", participants received two points for writing "$107.79". Any other answer received no points. Each participant's points were added for the six questions and then divided by a total possible 44 points. This figure was then multiplied by 100 and rounded to the nearest whole number to result in a percentage representing the participant's overall retention score.

Table 4-2: Questions, answers and corresponding points awarded during the retention test.

Question		**Answers**	**Points**
1	What is the stock price?	$107.79	2
2	What is the 1 day, 1 month & 1-year stock price percentage change?	1 day: -0.65% 1 month: -1.11% 1 year: 2.02%	2 2 2
3	What is the market cap? Describe its ranking amongst peers and percentage change over 1 and 5 years.	$917bn total market cap 3rd amongst peers 1% change over 1 year 5% change over 5 years	2 2 2 2
4	What was the 2018 revenue? Describe its ranking amongst peers and percentage change over 1 and 5 years.	$810bn in revenue in 2018 1st amongst peers 1% change over 1 year 2% on average over 5 years	2 2 2 2

5	What is the average percentage change in revenue of technology companies in the S&P 500 over the last 5 years?	1.8%	2
6	Describe the news headlines.	Streaming Lost subscribers Growth in earnings Successful products Payments product Doubled market share	2 4 4 2 2 4
			44

4.6.4. Transfer test

To reveal whether a modality effect was present or not, a transfer test was carried out. This involved assessing each participant's ability to apply information received during testing to solve problems. Three questions were asked regarding the information presented during both visual and audio/visual presentations. Table 4-3 presents each question asked during the transfer test, possible correct answers and the corresponding points awarded. Each participant's points were added for the three questions and then divided by a total possible 30 points. This figure was then multiplied by 100 and rounded to the nearest whole number to result in a percentage representing the participant's overall transfer score.

Table 4-3: Questions, answers and corresponding points awarded during the transfer test.

Question		**Answers**	**Points**
1	How would you describe the stock price performance over the short and long term?	Short term: Any negative wording 1 day/short term Long term: Any positive wording	 2 2 2

		1 month/1 year/long term	2
2	How would you describe the stock's performance against its peers?	Regarding revenue: Any positive wording Revenue Regarding market cap: Any positive wording Market cap	 2 2 2 2
3	How do you interpret the news headlines in relation to this stock?	Regarding overall sentiment: Any positive wording Regarding the first headline: Any negative wording Streaming Regarding the second headline: Any positive wording Earnings Regarding the third headline: Any positive wording Payment products	 2 2 2 2 2 2 2
			30

Table 4-4: RepGrid analysis and modality effect testing summary.

Chapter 4: RepGrid analysis and modality effect comparative testing
RepGrid Analysis

Date Span	5/8/19 – 23/8/19
Interview Type:	Individual
Number of Participants:	4
Average Interview Time:	28 minutes
Tools Used for Analysis:	Google Forms, Google Sheets
Transcription Method:	Written in interview then typed into Microsoft Excel.
Choice of Interviewee	Interview participants were key informants selected from a group of investors running and managing a retail investment fund who are willing to share their experiences with systems they've used to receive investment-related information.
Triadic comparison:	
• In what way are two of these three elements similar to each other and different from the third?	
Laddering:	
• Which pole do you prefer and why?	
Respondent rating:	
• Using a 5-point Likert scale, rank each element with one referring to the likeness pole and five referring to the contrast pole.	
Modality effect comparative testing:	
Date Span	5/8/19 – 23/8/19
Test group size:	Individual
Number of Participants:	14 (7 in the audio/visual test group and 7 in the visual test group)
Average Interview Time:	22 minutes
Tools Used for Analysis:	Microsoft Excel
Transcription Method:	Written in interview then typed into Microsoft Excel.
Choice of Interviewee	Interview participants were considered to be key informants as they are selected from a group of investors running and managing a retail investment fund and who are willing to share their experiences with systems they've used to receive investment information. No participants from the RepGrid analysis participated in the modality effect comparative testing.
Questions asked per test:	
Retention test:	1. What is the stock price? 2. What is the 1 day, 1 month & 1-year stock price percentage change? 3. What is the market cap? Describe its ranking amongst peers and percentage change over 1 and 5 years. 4. What was the 2018 revenue? Describe its ranking amongst peers and percentage change over 1 and 5 years.

	5. What is the average percentage change in revenue of technology companies in the S&P 500 over the last 5 years? 6. Describe the news headlines.
Transfer test:	1. How would you describe the stock price performance over the short and long term? 2. How would you describe the stock's performance against its peers? 3. How do you interpret the news headlines in relation to this stock?

4.7. Testing results

According to modality effect literature, audible information displayed concurrently with related, visual information enhances learning more effectively than visual information on its own. A reverse modality effect is obtained when only visual information enhances learning more effectively than audible information displayed concurrently with related, visual information. Following testing with both the Visual Test Group and the Audio/Visual Test Group, results were noted from transfer and retention tests. The results were then compared to identify any disparity between each testing group's performance during the experiment. Retention of information and transfer of information were tested in order to identify whether the modality effect was present or not and to investigate how effectively each group processed the information presented.

Table 4-5 illustrates how the Visual Test Group outperformed the Audio/Visual Test Group on average regarding retention of information (Audio/Visual Test Group 23% vs. Visual Test Group 39%). Previous modality effect findings suggest that participants should retain more information during testing when verbal information related to onscreen visuals is presented audibly instead of visually. This finding suggests a reverse modality effect in the case of information retention. Considering the Audio/Visual Test Group, who received verbal information related to onscreen visuals during testing, were outperformed by the Visual Test group who received only onscreen information, a reverse modality effect is evident. This result is the opposite of what was expected with the modality effect.

Table 4-5 further illustrates how the Visual Test Group outperformed the Audio/Visual Test Group on average regarding transferring information (Audio/Visual Test Group 30% vs. Visual Test Group 46%). Previous modality effect

findings suggest that participants should transfer information to provide problem-solving solutions during testing when verbal information related to onscreen visuals is presented audibly instead of visually. Again, the Audio/Visual Test Group, who received verbal information related to onscreen visuals during testing, were outperformed by the Visual Test group who received only onscreen information. As a result, these findings also reveal a reverse modality effect; this is inconsistent with the predictions of the modality effect.

While retention and transfer of information amongst both groups yielded a reverse modality effect, the time spent processing information and answering questions during testing revealed an interesting disparity between the groups. On average, the Audio/Visual Test Group took 24 seconds less to process information, 22 seconds less to answer retention questions and 2 minutes less to answer transfer questions, than the Visual Test Group. Considering the Audio/Visual Test Group were outperformed by the Visual Test Group in retention and transfer of information, it is plausible that the lower average time spent answering the corresponding questions is a result of less detailed answers. However, the Audio/Visual Test Group's lower average time spent processing information provides potentially interesting implications. Participants from both test groups could finish processing the information provided whenever they felt ready to move onto the next section of testing. Participants' from the Audio/Visual Test Group felt adequately prepared to answer questions based on the information displayed in less time than participants from the Visual Test Group. This suggests that combined audible and visual information results in quicker response times than solely visual information. However, lower retention and transfer scores suggest that while Audio/Visual Test Group are quicker to respond when processing audible and visual information, they are less accurate when transferring and retaining this information. Given this information is intended to be retained and transferred to inform an investment decision, this trade-off of accuracy for speed can result in erroneous investment decisions and subsequent financial loss.

Table 4-5: Results for the Audio/Visual Test Group and the Visual Test Group following testing of retention and transfer of information with audio/visual and visual systems respectively.

Averages	**Audio/Visual Test Group**	**Visual Test Group**
Time processing information before questioning	00:02:51	00:03:15
Retention score	23%	39%
Time answering retention questions	00:02:59	00:03:21
Transfer score	30%	46%
Time answering transfer questions	00:01:38	00:03:08

4.8. Discussion

The chapter contributes a number of findings to the evaluation of information modality in the context of retail investors. Through a RepGrid analysis with key informant interviews, preferable system features and requirements were gathered to build a POC for testing. The findings of the RepGrid analysis suggested retail investors prioritise visually condensed information, the use of visual cues, user-paced system interaction and a concurrent presentation of audio and visual information for the audio/visual system. The RepGrid analysis also suggests a priority of short and concise information over longer detailed information when analysing a stock's performance historically and its comparison to peers. Results from the RepGrid analysis also revealed a disinclination amongst participants towards the successive display of audio/visual information and system-paced interaction.

In testing retention and transfer of information, it was initially predicted that the combination of concurrent and related audio/visual investment information would allow participants to retain and transfer information more effectively than participants receiving solely visual investment information. This would be consistent with the modality effect which states that learning is enhanced when related audio/visual information is processed concurrently. This study examines whether or not the modality effect can enhance the ability of retail investors to learn from investment-related information and improve subsequent investment decisions. The opposite was observed, with participants receiving solely visual investment information

outperforming participants who received concurrent and related audio/visual investment information in both retention and transfer. This finding is referred to as a reverse modality effect. This implies that an investor's ability to learn from investment-related information is impaired when information is provided in an audio/visual format and will result in subsequently less informed investment decisions. Further evidence that investor decisions are diminished by audio/visual information is suggested by the quicker response times of participants in the Audio/Visual Test Group. While quicker to process information, lower retention and transfer scores are observed. This suggests that investors processing audio/visual information are less accurate when transferring and retaining this information. Given this information is intended to be retained and transferred to inform an investment decision, this trade of accuracy for quicker responses can be at the expense of less informed decisions.

Based on previous literature it is plausible that these findings can be attributed to the inclusion of visual cues. Visual cues were used primarily with numerical, text-based information onscreen; for example, a decrease in price percentage change was displayed with red font and an increase in price percentage change was displayed with green font in both the visual and the audio/visual POC. Market capitalisation and revenue figures were highlighted using bold font. The intention of these visual cues was to reduce the visual search for participants. Considering the use of visual cues was associated primarily with numerical information, i.e. percentage changes in price, market capitalisation and revenue figures, it is reasonable to consider the presentation of numerical information to be more beneficial and effectively processed when presented visually. The audible information presented to the Audio/Visual Test Group contained a substantial amount of numerical information relative to what was displayed onscreen. Audible information regarding market capitalisation, revenue and news were largely numerical; the lower test scores for retention and transfer of information for the Audio/Visual Test Group could be to a certain extent, attributable to this. In order to improve the performance of the Audio/Visual Test Group, all numerical information could be presented onscreen using visual cues, supplemented by relevant audible information.

It is also plausible that these findings can be attributed to insufficiently short and concise information. The intention of the audio/visual POC was to provide audible

information that was as short and concise as possible, but sufficient for participants to answer questions appropriately during testing. Despite this, responses from Alexa averaged thirty-seven words in length to provide full answers to each participant's question. While the intention was to provide short and concise audible information, it is plausible that thirty-seven words per answer is excessively long regardless of complexity. This finding is consistent with the reverse modality effect which, in the context of this study, suggests that longer, audible information impairs an investor's ability to learn from investment-related information and results in less informed investment decisions. With this in mind, it is reasonable to emphasise that in the context of retail investor decision-making, for audio/visual information to be effective, audible information must be shorter in length than in this study's testing scenarios. It is also plausible that audible information may be effectively used as a supplement to text, reiterating certain important pieces of visual information instead of presenting the information in a solely audible mode.

One noticeable limitation of this study is the use of the RepGrid analysis as an interviewing technique. While the RepGrid analysis has been considered as applicable and beneficial in the context of information systems (Bernard & Flitman, 2002), the interviewing procedure requires participants to recall experiences and preferences with familiar systems. This study derived requirements from this feedback and built system features and functionality accordingly. Considering the recency of voice assistant technology and its relatively unexplored use in the context of retail investing, RepGrid participants are more likely to inform what system features are preferred when using a more familiar visual system. Perhaps in order to identify additional benefits of audio/visual systems in a retail investing context, features identified as beneficial outside the context of retail investing should be considered. The discussion of this limitation is intended to suggest directions for future research and shed light on areas and methodologies to further explore findings.

4.9. Conclusion

From a practical implication perspective, this study identifies that following further research and refinements, the inclusion of audible information to retail investment platforms is an area of significant potential. The audible information used in this study was found to be excessive in length despite efforts to remain as concise as possible. The length of audible information needs to be further reduced. Similar findings were

noted during the study regarding numerical information. Numerical information was regularly presented audibly; however, it was shown to be more effective when presented visually. This suggests that for audible information to be presented and processed effectively, non-numerical audible information should be used to supplement visual numerical information highlighted with visual cues. In summary, a major advance in this study was determining the inferiority of audible information over visual information with retail investors. However, these findings should not be taken as a rejection of the use of audible information with retail investors. Adjustments in information length and the priority of non-numerical, audible information could be of significant benefit when designing future systems and could lead to interesting and applicable findings following further research.

Another interesting finding of this study highlights how the inclusion of audible information results in quicker response time among investors. This tendency among investors to make quicker decisions suggests increased confidence in the information received, however, is at the expense of less informed and perhaps erroneous investment decisions.

Chapter 5. Discussions and conclusions

The following section concludes the thesis by providing an overview of the research. Each element of the research, presented in the chapters, and the corresponding research questions will be revisited. How the questions were answered and what was learned will be outlined. Following on from this, contributions to existing research will be described, highlighting findings on how online investors process and receive information. The next section will then describe contributions to practice. This will highlight the relevant suggestions presented from this thesis for practitioners in the domain of online investing. From there, the limitations of the research conducted are outlined. This will lead to the discussion of future research opportunities to explore how information is processed and received by online investors, through the lens of copy trading, social media and information modality.

5.1. Summary of the research questions

In order to address the multi-faceted nature of exploring how information is processed and received by investors, three separate research questions were derived. These research questions were answered over three chapters, by exploring ways investment-related information is available to online investors. The thesis objective was explored through three lenses: the lens of copy trading; the lens of online investor social media usage; and the lens of information modality.

In section 2.2, social trading networks are highlighted by existing literature as an emerging means of receiving investor information. Berger et al. (2018) discuss specifically how copy trading within these networks allows investors to realise improved returns. Social trading networks allow investors to publicly publish their investment decisions in real-time which other participants can copy, this functionality is referred to as copy trading (Doering, Neumann, & Paul, 2015). Glaser and Risius (2018) describe how this level of transparency provides new information which investors can use to inform their investment decisions. Investors are provided with highly detailed information regarding others' investment decisions and can use this to avoid excessive analysis and further inform their own decisions (Oehler, Horn, & Wendt, 2016). The growing popularity of social trading networks suggests that the investment information available via copy trading is becoming more influential in

online investor decisions. By examining what drives participants in social trading networks to engage in copy trading, a new way in which online investors process and receive information is explored. This concept led to the first research question.

> Research Question 1: What drives participants in social trading networks to engage in copy trading?

To identify the drivers of online investor engagement in copy trading, a systematic review of existing literature, as discussed in section 2.3, was conducted (Webster & Watson, 2002). As per the guidelines of the systematic review, key concepts from literature were extracted and analysed to form a concept-centric matrix. This concept-centric matrix was then used to develop a theoretical framework which, in section 2.5, describes usefulness, perceived ease of use and perceived enjoyment from Davis's (1989) TAM as underlying drivers of investor engagement in copy trading. Findings from Chapter 2, as discussed in section 2.7, highlight that Davis's (1989) TAM reveals underlying drivers of investor engagement in copy trading to a certain extent. However, signal provider trustworthiness (Wohlgemuth et al., 2016), is required to extend the framework to fully model what drives online investors to engage in copy trading.

The study highlighted the underlying subcomponents of perceived enjoyment in copy trading as the self-attribution bias, the illusion of knowledge, and the illusion of control. While identified as drivers of perceived enjoyment in copy trading, early online investing literature describes how the self-attribution bias, the illusion of knowledge, and the illusion of control cause overconfidence among online investors (Barber & Odean, 2002). These reasons for overconfidence have been validated by existing research, however not in the context of using social media to inform investment decisions. Social media usage has been identified in existing literature as influential over online investor decisions and market movements (Bollen et al., 2011; Karabulut, 2013; Siganos et al., 2014). Online investors can base these decisions on the vast amount of easily accessible, investment-related information on social media. The identification of this gap in existing research resulted in the development of the second research question.

> Research Question 2: How is online investor overconfidence impacted by social media usage?

To identify overconfidence among online investors, who use social media to gather investment-related information, it was necessary to identify the causes of this overconfidence. Previous literature highlights overconfidence as a product of the self-attribution bias, the illusion of knowledge, and the illusion of control (Barber & Odean, 2002). These causes of overconfidence are identified in Chapter 2 as drivers of perceived enjoyment in copy trading; however, to answer Research Question 2, these characteristics are examined as causes of online investor overconfidence in the broader context of general social media usage. By examining these characteristics among online investors who both use and don't use social media to inform investment decisions, the impact on online investor overconfidence of gathering investment-related information on social media was revealed. Results from Chapter 3, discussed in section 3.6, showed the self-attribution bias, the illusion of knowledge, and the illusion of control among investors who use social media to gather investment-related information, corroborating the findings of Barber and Odean (2002). This suggests that these investors are overconfident. In contrast to Barber and Odean (2002), online investors who do not use social media to gather investment-related information demonstrated the illusion of knowledge and the illusion of control; but not the self-attribution bias. Results also showed that cryptocurrency investors rely more heavily on social media than online stock market investors when gathering investment-related information.

The first two research questions focus on different aspects of how investors process investment information from social trading networks and social media generally. While these research questions address how investors process investment-related information from online sources such as social trading networks and social media, the communication of this information to investors isn't examined. The growing pool of literature, examining the emergence and effectiveness of combined audible and information (Leahy & Sweller, 2011) and voice-based interaction (Ghosh, Foong, Zhang, & Zhao, 2018), suggests that the way information is communicated is changing. The communication of audible, investment-related information has not been thoroughly examined by existing literature. Based on this, the third research question was derived.

Research Question 3: Can the combination of audible and visual information enhance an investor's ability to learn from investment-related information and ultimately better inform their investment decision?

To investigate the impact of combined audible and visual information on investor decision-making, literature in information modality was reviewed and analysed. This literature has identified the modality effect, which states that an individual's ability to learn from information is enhanced when related information is communicated in two combined modes: audibly and visually (Low & Sweller, 2005). Based on this, the impact of combined audible and visual information on investor decision-making was examined by testing for the modality effect among investors. Recent devices such as the Amazon Echo Show communicate information concurrently in two separate modes: audibly and visually. By communicating investment-related information to investors using this device, the modality effect, and the subsequent impact of combined audible and visual information on investor decisions was tested.

The results of these tests, discussed in section 4.7, showed a reverse modality effect, suggesting there is no benefit to investors by replacing text with audio when accompanying related visual information, contrasting Low's and Sweller's (2005) description of the modality effect. Investor decisions are better informed when investment-related information is communicated in a solely visual mode, consistent with previous findings of a reverse modality effect (Inan et al., 2015; Leahy & Sweller, 2011). An additional observation was that the communication of combined audible and visual investment-related information resulted in investors taking a shorter amount of time on average, to process information than the investors using the solely visual system. However, this quick response time causes participants to process information with less accuracy, leading to erroneous decisions. This further validated the finding that the solely visual communication of investment-related information is more beneficial to investor decision-making.

5.2. Contribution to research and practice

This thesis presents contributions to a variety of fields including social trading, online investor social media usage, and information modality in the context of investing; however, the common contribution throughout was the exploration of online investor information. The findings of the second chapter can help researchers understand the

drivers of online investor engagement in social trading and provide guidance on the ways online investors process the investment-related opinions and decisions of other investors online. The research identified that Davis et al.'s (1992) technology acceptance model must be extended when applied to the context of copy trading, as described in section 2.7. While perceived usefulness, ease of use, and enjoyment are validated as drivers of technology adoption, the complexity of the drivers of investor engagement in copy trading requires the addition of signal provider trustworthiness as an exogenous factor. This factor was found to mediate the relationship between an investor's decision to engage in copy trading and TAM's core constructs. Section 2.7 also sheds light on the importance of trust in engaging in copy trading, corroborating the findings of Wohlgemuth et al. (2016). The decision to copy a signal provider's trades has financial consequences, therefore, naturally requires trust. It is highlighted that for further research to effectively explore copy trading, trust between followers and signal providers will need to be further investigated. This chapter also provides several practitioner implications, highlighted in section 2.8. The chapter's framework shows that platform developers must prioritise transparent personal and performance signal provider information to build trust with investors. The framework also suggests that, based on perceived usefulness, ease of use, and enjoyment, social trading platform providers and marketers should identify and emphasise the features that users benefit from, find easy to use, and enjoy. Examples include the performance benefits of copying a signal provider's trades, or the ease with which inexperienced investors can realise improved investment returns as a result of copy trading.

Regarding the usage of social media by online investors, several implications for both researchers and practitioners were discussed in section 3.7. By using social media to gather investment-related information, it was found that online investors become overconfident as a result of the self-attribution bias, the illusion of knowledge, and the illusion of control, consistent with Barber and Odean (2002). This suggests that online investors intending to use social media to inform their investment decisions should first consider what they attribute to investment outcomes, how the volume of information available to them affects their decision making and whether or not by investing directly themselves, they feel as if their chances of improved returns have increased. Another finding was that there is a greater tendency among cryptocurrency investors to gather investment-related information on social media. This finding

suggests that social media is a particularly effective channel for insights into the trends and behaviours of cryptocurrency investors. Additionally, the self-attribution bias, the illusion of knowledge, and the illusion of control are further tested as a means of identifying overconfidence among online investors and, in particular, among online investors who use social media to gather investment-related information. It is also found that online investors who do not use social media to gather investment-related information do not demonstrate the self-attribution bias. This contradicts the findings of previous literature (Barber & Odean, 2002) and can be validated by further research.

In exploring the impact of the modality effect on online investor decision-making, contributions to practice and research were identified. The analysis of audible and visual system features has implications for both practitioners and researchers as discussed in section 4.9. From a practical perspective, this study identifies that combined audible and visual information has potential in communicating online investor information but needs further consideration. Firstly, the length of audible information needs to be reduced for it to be processed effectively by investors. Numerical information was found to be processed ineffectively when communicated audibly, suggesting that the visual mode is more effective when communicating numerical information to online investors. Results showed that investors are quicker to respond to combined audible and visual information; however, this sacrifices accuracy in processing the information. This suggests that the audible supplementation of visual, numerical information could be beneficial to online investor decision making, however, it requires further investigation. In order to effectively test the impact of combined audible and visual information on investor decision-making, the design of systems to be used for testing should incorporate shortened audible information and supplementary audible information for visual, numerical information.

5.3. Limitations of research

All research has limitations and it must be accepted that there are limitations with the research presented in this thesis. An increased sample size could be used to validate the findings presented during this thesis. Key informant interviews with smaller sample sizes are identified during existing literature as an effective way of gathering insightful data in areas where underlying topics or concepts are not well understood (Babbie, 1998). While this was largely applicable to the research conducted during this study, larger sample sizes of both retail and institutional investors with varying

experience levels and familiarity with a variety of investment asset classes could provide additional insights and further validate the results of research presented in this thesis.

A limitation of this study arose regarding the use of semi-structured, qualitative interviews to gather data as described in section 3.5. Myers and Newman (2007) highlight this interview method as useful for further exploring certain topics based on a participant's answers, but at times, the interviews strayed from the research objective in question. By conducting both structured and semi-structured interviews with the same participants, answers could stay more relevant to the research objective as well as providing the additional detail from refining certain answers during semi-structured, qualitative interviews.

Another limitation encountered involved the development of the Amazon Alexa POC testing system. To develop appropriate system features and functionalities, a RepGrid analysis (Bernard & Flitman, 2002) was described in section 4.5 as a method for gathering audio/visual system requirements. Considering the recent nature of voice-based user interfaces and their relatively unexplored use in the context of retail investing, participants are more likely to inform what system features are preferred when using a more familiar, visual system. In order to further explore the usability of combined audible and visual information in the context of online investing, beneficial features of audible and visual systems outside the context of retail investing could be considered.

5.4. Overall findings and future research opportunities

The research objective of exploring how investors process and receive information online is met firstly by investigating how investors process this information via copy trading in Chapter 2. It was revealed that providing full transparency with others' investment decisions, results in a growing tendency among investors to imitate the decisions of others on social media. It was also found that the willingness of online investors to copy others' investment decisions is ultimately determined by trust in the investor they're copying, consistent with Wohlgemuth et al. (2016).

Findings also revealed overconfidence among these investors who use social media to inform their investment decisions. Ultimately, the exploration of how investment-related information is received online has highlighted the growing use of social media

to imitate others and inform investment decisions, consistent with Barber and Odean (2002). While certain social media platforms have been highlighted as predictors of market movements (Bollen et al., 2011), the investment-related information made available by social media may not be beneficial according to the research conducted in this thesis. The large volume and variety of information provided by social media causes overconfidence among investors which can then reduce returns.

The final element of the overall research objective of this thesis examined how investment information is communicated to online investors. Specifically, the use of voice-based assistants communicating combined audible and visual information was explored. Findings revealed that investor decisions are more informed when information is communicated visually, consistent with previous findings of a reverse modality effect (Inan et al., 2015; Leahy & Sweller, 2011). When certain pieces of visual information were replaced by audible information, an investor's ability to make informed decisions deteriorated.

To conclude, this thesis shed light on how investors can process and receive investment-related information online. By identifying that overconfidence among investors is caused by the large volume and variety of investment-related information available on social media, an opportunity is presented to explore reduced, or a more cautious approach to, social media usage as a potential mitigator of online investor overconfidence. Additionally, this thesis presents research that suggests the communication of combined audible and visual information is less effective than the communication of solely visual information to investors; however, these findings offer insights into the design of system features to communicate combined audible and visual information more effectively to investors.

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Appendix A

2019

Future of Investing: Industry Report

STATE STREET ADVANCED TECHNOLOGY CENTER, UNIVERSITY COLLEGE CORK
AODÁN COTTER, ANTHONY CREED, LUKE MERRIMAN

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The Past: The Dawn of Online Investing

Online investing is the act of traders and investors using online services and trading platforms offered by brokers. While it has had an undoubted boom in the twenty-first century, the history and dawn of the industry stems back years.

The first web brokerage firms broke into the industry of online trading in 1994 when K. Aufhauser & Company Inc. launched their online trading platform: WealthWEB. This company was later acquired by TD Ameritrade which is today, one of the world's most popular online trading platforms. By 1999 there was more than twelve million users of these platforms as more than one-hundred and twenty e-brokerage platforms were available. This increase in users was aided by the fact commissions on trades had dropped by 50% since the initial platform had been launched in 1994, making the service much cheaper and accessible for the regular user. Other benefits drawing in new users was the fact people felt much more in control and they had greater ability to access global markets.

Users were however, inexperienced for the most part and had over confidence in online materials. This led in part to DOTCOM stocks inflating massively. Then when DELL and CISCO stock were sold in large number it caused the whole bubble to burst which caused losses of $1.7 trillion.

Current Technologies Used to Invest

The primary technologies used to invest in finance at the moment are all visual. Laptops and PCs are primarily used with 162 million sold worldwide in 2018. The larger processing power of PCs was even more attractive with 260 million sold worldwide.

While investing from the office desk is still the preferred method, tablets and smartphones in todays day and age are also being used. This is a big development in recent years as before investing from the palm of your hand would have been impossible.

This allows investors to make decisions much easier and allows quicker access to the information. All of these devices heavily rely on the visual element (although smartphones do now have Voice Assistants) which shows the neglect of the audio function. This extra mode of communication has the ability to increase the personalization of an individual's investment

experience. Research into information modality has shown effectiveness of providing audio and visual information in tandem with each other.

Current Methods of Information

Presently, financial information comes from three different sources: Traditional intermediaries, self-diligence and social media. While the traditional intermediary was the main option for years, social media and websites providing financial info have begun to gain a foothold recently.

Traditional Intermediary: Well established sources of information. Providing a trustworthy platform to invest. Fidelity and TD Ameritrade offer financial advisors, ranging from Hedge funds to private equity.

Self-Diligence: Spawned from the creation of internet- 1997. Provides overview of the general market. This valuable information is free to access to anyone with an internet connection. Offering information such as current news and price changes.

Social Media: New social platforms for investors to access information. Reddit allows you join specific investment communities where you can interact with like-minded individuals. You can follow experienced investors on Twitter or certain investment news outlets.

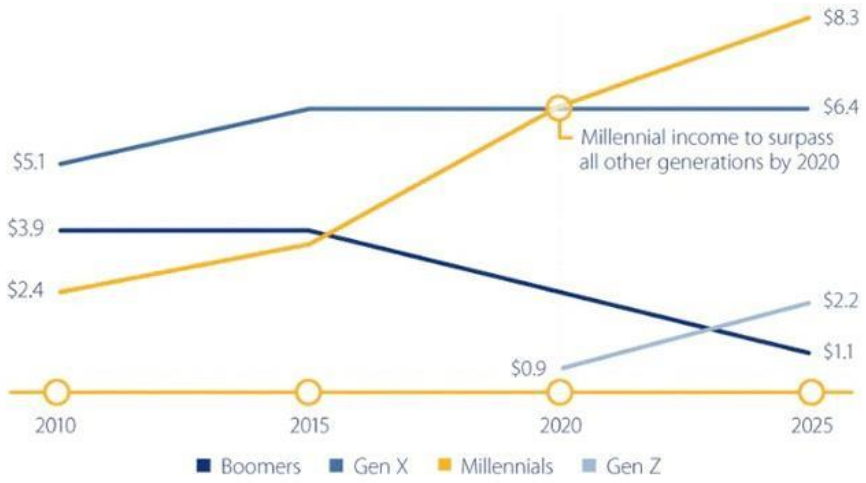
Industry Disruption

Value of Information: Costs of advanced technology reducing (smartphones) and the speed at which an individual can access information (internet). Institutions who previously held the majority of sought-after financial information, have had the industry disrupted by the democratization of this information. With the aforementioned social media growth, the digestion of investment information has never been easier with relevant information being so easily distributed. Deloitte's investment management outlook 2016 viewed advances in technology as a method to reduce the cost of portfolio management.

A method of combatting this rapid shift is for these institutions to acquire new innovative FinTech businesses to integrate with the processes that exist already. This allows cheaper entry into the retail investment market that traditionally would be far too expensive to enter.

Emerging Investors

The emerging investors of the next 5-10 years will be people born between 1980-1995. These people are now classified as millennial investors and they are a vital market in the future. In the USA alone, there are 76 million people within this demographic



Graphic taken from VISA.com

This demographic is extremely important to factor into future investing as by 2020 they will make up one third of the US population and by 2025 they will comprise three quarters of the US workforce, meaning future of investing will be dominated by them.

This generation are the first to have grown up with the internet and modern technology properly integrated into their lives. However, they show a distinct lack of social trust due to the fact many grew up during the financial crash of 2008.

This has led to new investors straying from the regular investment instruments and veering towards more innovative ways of making money. Social trading and Initial Coin offerings are just two of these new products emerging that have seen significant investment in recent years.

Disintermediated, transparent and socially responsible investments are appearing to be appealing to these millennial investors. These can come in the form of ICO investments or Environmental, Social and Governance investments. Traditional Investment Intermediaries are having to adapt to the demands of these new investors.

Emerging Investments

ICOs

Who are the people investing: Poll by crypto finance company Circle showed that 25 percent of millennials said they are interested in purchasing digital currencies over the next 12 months, which sets them apart from other generations by more than 10 percent.

Valuation: Web browser Brave's ICO generated $35 million in less than 30 seconds. ICO value in October 2017 year-to-date (YTD) was $2.3 billion, ten times greater than calendar year 2016.

What is their appeal: It is possible to reduce the costs of capital raising, avoiding intermediaries and payment-agents. Blockchain possesses the ability to replace middlemen with mathematics, this is achieved by transfer the ownership of assets directly from one party to another. The use of Cryptography makes the chances of fraud and theft almost impossible, providing a high level of security to investors.

What concerns are there: Little to no standard regulation exists over this investment area. China, South Korea among countries to outright ban ICOs. "An ICO must be conducted in a manner that promotes investor trust and confidence" - Australian market authority. Facilitated the use of Bitcoin in the WannaCry ransomware virus. The market is also extremely volatile with huge swings in price occurring regularly with no apparent reason.

Outlook: With Europe, America, and most of Asia set to increase regulation and accountability of ICOs [8]. The future of this investment method is positive, albeit without the huge market fluctuations.

ICOs – Ready for the Institutional Investors?

If the ICO market has seen so much potential for enormous profits, why hasn't the institutional investors shown more interest?

Risk: This new method is extremely volatile and seems to swing massively without proper validation.

Regulation: As mentioned earlier, the lack of regulation and outright ban in certain countries is a huge reason for the hesitation to adopt.

Perception: Public perception views ICOs as enabling cyber-crime and as a gimmick.

Potential: Some large companies are investing in the Blockchain technology behind ICOs and betting on the market becoming more mainstream. As more companies back this technology, the greater the potential returns will be, along with an increase in public trust.

Examples: Facebook, JP Morgan, Bank of America, Apple, Axa Group.

Alternative Investments – An Institutional Perspective

Alternative investments such as Crowdfunding, P2P lending, and ICOs have been commonly associated with the retail investors. This type of investment is, for the most part, not within the scope of institutional investors. Alternative Investments that appeal to this group include private debt/equity, and infrastructure. A report into the alternative investment sector was conducted by Prequin in 2018, based on surveys from 300 fund managers and 120 institutional investors. This report revealed this market could be worth over $14 trillion by 2023.

Their data shows that investors plan to increase their allocations to three major categories in the next five years: 79 percent said they would increase their private equity allocation, 70 percent plan to boost allocations to infrastructure, and 62 percent plan to increase allocations to private debt. Private equity assets are expected to increase by 58 percent over the next five years, overtaking hedge funds as the largest alternative asset class, according to the report. The private debt market is expected to double in size, reaching $1.4 trillion in size by 2023, according to Preqin.

With this increase in alternative investment options, the amount of investment firms is set to grow substantially and an increased level of competition will be seen, there are expected to be more fund managers available for allocators to choose from in 2023. Preqin data show a projected 21 percent increase, bringing the total number of fund management firms to 34,000 in 2023.

Future Growth: Developing economies such as Africa and South-East Asia are set to become major markets in the alternative investment ecosystem. 84% of investors plan to increase their allocation to alternatives in the next five years. By 2020, emerging economies will likely make up over 60% of the world's GDP.46% of fund managers plan to increase their investment in Africa by 2023.

Social Influence and Peer Referral

81% of people aged 20-35 are on Facebook, where their generation's median friend count is 250. Many firms have begun to use Twitter as a form of communicating news to consumers and investors because of its appeal and focus on the 140 characters enabling people to communicate concise, valuable information. ''Wisdom of the crowds'' mind-set, potential investors can discuss openly across many different mediums to help them make a financial decision.

Social media and specialized trading websites are making the exchange industry more accessible and approachable. They are helping to simplify terms and conditions. Also, these online social communities of traders are offering support where necessary to educate their audiences. Those with minimum experience can rely heavily on people they perceive have insider knowledge on a potential investment. In 2013, one tweet from billionaire Carl Icahn was all it took to see Apple's stock soar. In fact, the stock gained $17 billion in a matter of minutes.

Reddit, a social discussion platform, has become the primary research point for many investors. The ability to discuss with like-minded individuals is a major benefit. Communities such as r/investing boasts over 700'000 active members. Social Trading has become increasingly popular as more people are influenced by what other investors are trading.

Social Trading Platforms

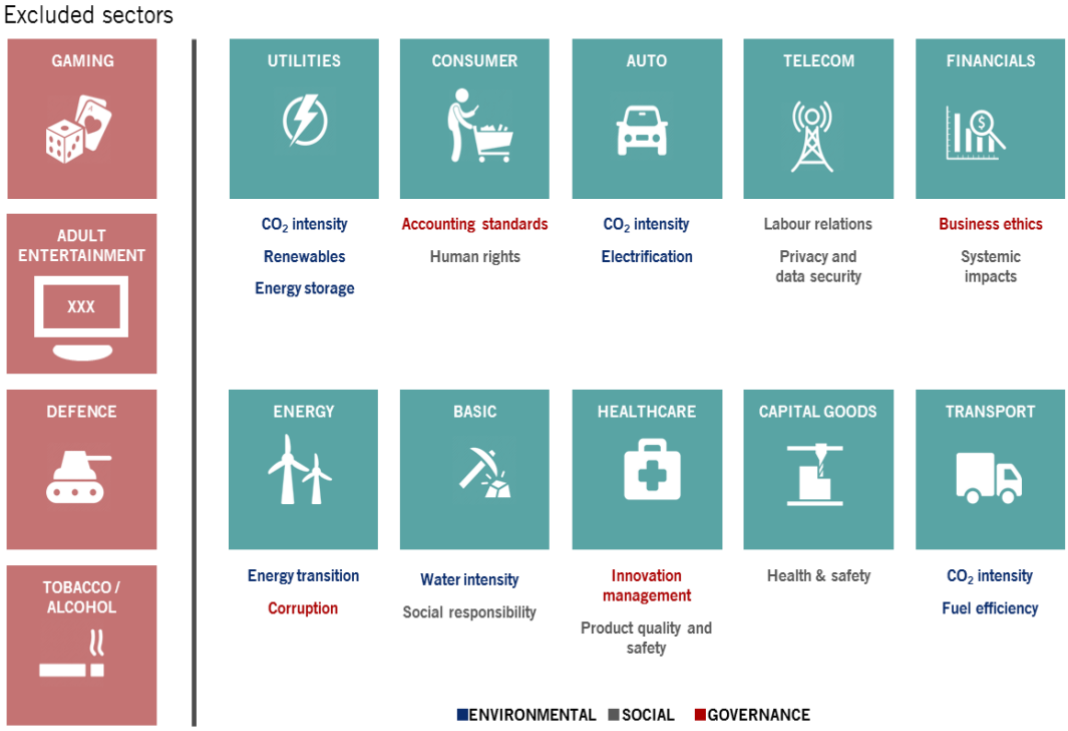
EToro: By depositing funds with the site, you can execute trades based on strategies developed by other members. Strategies include asset classes such as FX, indices, commodities, stocks, ETFs, and others. Fees are captured in the bid/ask spread rather than through a monthly payment.

Scutify: It features a scroll of posts from various members with their commentary on stocks. Post are broken up into channels and hashtags. 'Scutify Sentiment Indicator'. It allows you to quickly see the sentiment of members for a particular stock.

StockTwits: The platform integrates with Twitter, so you are getting posts from people posting on Twitter and to StockTwits. A heatmap allows you to see many stocks at once. The redder the heatmap, the more negative prices there are for stocks listed. You can drill down further into different groups of stocks.

Evironmental Social Governance (ESG)

Environmental criteria consider how a company performs as a steward of nature. Social criteria examine how it manages relationships with employees, suppliers, customers, and the communities where it operates. Governance deals with a company's leadership, executive pay, audits, internal controls, and shareholder rights.



The above image describes all the sectors of business that fall under each section. Such as Human rights, Renewable Energy, and Ethics. Investors are becoming increasingly aware of all these factors when looking to invest. For younger investors, Climate Change has become the most important ESG factor. The people investing in these products are a generation that is willing to pay more for a product if they know the investment is going to a good cause. With the massive reach social media has provided, companies must factor in massively social responsibility.

Companies have had to adapt to this demand for ESG information on the investment options they supply. In private markets, the UN Principles for Responsible Investment (PRI) reports that two out of every three LPs consider responsible investment in their selection of fund managers, while Preqin's data shows that nearly half of alternative fund managers will consider ESG principles in every investment they make by 2023. In private capital, ESG will become more polarized around "E" and "G", casting light on managing environmental and climate-related risks and governance issues. Green and specialized ESG funds will proliferate, many seeking to meet growing demand from LPs for such "clear-cut" ESG investments.

Businesses with better environmental, social and governance standards typically record stronger financial performance and beat their benchmarks, according to research from Axioma. The risk and portfolio analytics provider said the majority of portfolios weighted in favour of companies with better ESG scores outperformed their benchmarks by between 81 and 243 basis points in the four years to March 2018. Financial services companies such as JPMorgan Chase, Wells Fargo, and

Goldman Sachs have published annual reports that extensively review their ESG approaches and the bottom-line results.

Goldman Sachs- Report in 2018. **'**Green ETFs' have seen their numbers rise. From 2004-2014 only 24 were launched compared to 22 and 18 for 2016 and 2017 respectively.

JPMorgan- 2018 report. Aim to facilitate over $100bln in clean financing by 2025 and achieve 100% renewable energy usage by 2020.

Wells Fargo- 5-year goal covering diversity and social inclusion, economic empowerment, and environmental sustainability. Reported that 100% of global operational needs is met by renewable energy.

BlackRock - released an ESG report in February 2019. They discuss how sustainable investing is no longer a niche area and is becoming more mainstream for investors' portfolios.

State Street - Adapting to this need with the introduction of its R-Factor. This is State Street's internal measuring of the ESG level of investment options. They have conducted a survey and found Sixty-seven percent of Millennials place a higher value on making an impact, and they are investing to pursue values over the long term.

Future Technology

Voice Assistants

In the last 5 years the prominence of voice technology has grown significantly. The market is now worth $49 billion and this figure will only rise in the future. These devices allow for increased personalisation as the system learns from your responses and takes your personal information into account. This can be applied in future to financial setting which will allow the devices to recommend stocks and shares and share relevant news stories to the user. Some of the main products on the market are:

Amazon Echo Show



Bloomberg, Fidelity have developed Investment apps on Alexa Show. Currently developing a POC looking at aiding financial decisions for retail Investors.



Google Home:

Ability to ask Google Home about the stock market and have it return any big news in the current financial world.

Robo - advisory

Robo-advisory is another future technology sure to have a huge impact on the future of investing. Robot-Advisory allows the investor to interact with a system instead of a person, which then offers advice based on parameters entered. Mainly deals in the ETF Market. This market is worth $1bln, with potential to grow over $2.5bln by 2023. As Artificial Intelligence (AI) continues to become smarter, these recommendations will increase in accuracy. People will trust these Robo-advisors more and use traditional financial services less. Some companies have countered this by creating their own Robo-advisor.

Schaub Intelligent Portfolios- Min. of $5,000 to start. No commission.

Betterment Robo-Advisors. $15lbm AUM, 40,000 users.

Wealth Front Advisor. Suited for young investors due to $500 min investment.

Virtual Augmented Reality

Virtual Reality has seen significant growth in the entertainment sector, such as video games and providing a safe virtual environment for doctors, engineers, and architects. This industry is still very immature for use in the financial sector, specifically for trading.

Concerns: A major issue is the price of a system with one Oculus Rift costing $400, leading to limited adoption. Investors have been accustomed to viewing information on a screen or physical sheet, it will take some time for the idea of a virtual environment to become mainstream.

Future: Some features of everyday office life, such as Microsoft excel have been visualized. However, State Street is examining the viability of this technology as an aid in finance, using it to tackle the problem of data literacy.

Conclusion

The information presented in this report has explored the vast topic: The Future of Investing. Viewing the landscape in 5-10 years, all aspects were explored. Ranging from who will be the investors of the future, what they will be investing in, and how will they invest. The main takeaways from this report are:

- Investors no longer see ESG investment as a ‘nice-to-have’: The majority of investors now expect to see ESG information when making their investment decision. The Environmental aspect of investing is the largest sector with the rise of protests and demonstrations demanding decision makers take rapid action. In the next 5-10 years, this trend is only set to exponentially increase.

- Social Influence and Peer-Referral is playing a larger role: With the emergence of social media, the information gap between institutional and retail investors has decreased substantially. This access to investment information has drawn inexperienced investors which has helped spawn Social trading. Sites such as Etoro will continue to expand. Institutions still provide much richer information for decision making and will continue to own a large market share. However, these institutions would benefit from inserting themselves into the investment process of these inexperienced investors.

- Alternative Investments are set to exponentially grow: Equity/private debt, etc. are expected to become a major investment option in the next 5-10 years. Particularly for emerging economies which are set to take 60% of the world's GDP by 2023. Current institutions would benefit from exploring this market further and capitalizing on this opportunity.

Some Technologies are here, some still have a way to go: For investors, technology such as Voice Assistant Interaction (Alexa, Siri) are being integrated into the information search with the ability to personalize for each investor being a major advantage. AI/Robot-Advisory is already an established sector and positive growth signs. Virtual Reality use for investing is still at the infantile stage with current R&D projects exploring the use-cases. In the future, this technology may be available for investment decision making, but not in the current state.

Appendix B

Investors of the Future

Aodán Cotter
Anthony Creed
Luke Merriman

CORK UNIVERSITY BUSINESS SCHOOL

STATE STREET

STATE STREET GLOBAL ADVISORS

Todays Presentation

The purpose of this research was to identify and explore how emerging technologies help investors make financial decisions.

Approach: Amazon Alexa Echo Show POC
Industry Report
Academic Research Papers

CORK UNIVERSITY BUSINESS SCHOOL

STATE STREET

STATE STREET GLOBAL ADVISORS

Amazon Alexa Echo Show

Developed a ‘State Street’ experience for the Echo Show.

SSGA want to use the Echo Show to open up a new channel for customers to view & interact with.

Key Functionality

- General Queries about State Street products and key definitions (ex. KIID)
- Email documents to the user.
- SSGA videos can be viewed.
- View stock prices.
- Display the users profile.
- Examine current portfolio
- Invest in a stock

Industry report

- Examined the state-of-play and future trends for the investment ecosystem

Key Findings:

- Future investors (23-35) are increasingly interested in ESG investing
- Social media and social trading playing larger role in decisions. Reddit, Twitter, eToro.
- Alternative Investments 5-10 years. Equity/Private Debt growth. Emerging economies 60% world GDP 2023.
- Technology: Voice Assistant Interaction offering personalisation, Robo-Advisory continually growing. AR/VR still in developmental stages with potential use-cases.

Academic Research Conducted.

- Investor Decision making: The Impact of Modality on Investor Decision Making
- The Delegation of Investor Decision Making: What Drives Investors to Engage in Social Trading.
- The Impact of Social Media on Investor Trust. (Anthony paper)

Overall findings

- Amazon Alexa Echo Show has massive potential for SSGA.
- ESG and Equity/Private Debt investing continuing to grow.
- Combination of Audio/Visual information enables better investor decision making.

Amazon showcase

- General information queries
- Playing a SSGA Video
- Document email
- User profile
- Viewing portfolio
- Buying shares.